

REPORT DOCUMENTATION PAGE

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13. ABSTRACT (Maximum 200 Words) Over 380 people from 20 countries and 17 exhibitors attended the 4th annual joint meeting of Bird Strike Committee-USA and Bird Strike Committee Canada in Sacramento, California on October 21-24, 2002. Attendees included 91 U.S. Air Force and 7 Air National guard personnel. In all, 51 technical papers and posters were presented, including a special session of 5 papers dealing with the use of RADAR to detect birds to reduce collisions with aircraft. The conference also had a special pyrotechnics training course for 150 of the attendees. Highlights included presentations by representatives from the Air Line Pilots Association (ALPA) and Air Transport Association (ATA) regarding the need for greater action to minimize wildlife hazards on airports, which cost civil and military aviation worldwide over \$1.2 billion annually. The goal of BSC-USA is to increase communication and professionalism among the diverse groups dealing with wildlife issues on airports, and the 2002 meeting appeared to be highly successful in this regard.				
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BIRD STRIKE COMMITTEE U Sacramento, CA 21-24 October 2002**COUNTRY BREAKDOWN**

COUNTRY	REPS
Austria	1
Brazil	2
Canada	27
Denmark	1
Germany	2
Hungary	2
Iceland	2
Ireland	1
Italy	3
Mexico	2
Netherlands	1
New Zealand	1
Panama	2
Philippines	3
Portugal	1
Republic of China	2
South Africa	2
Sweden	1
Thailand	2
Uganda	1
United Kingdom	7
USA	316
22	382

ORGANIZATION BREAKDOWN

ORGANIZATION	REPS
AIRPORT/AVIATION INDUSTRY	69
FAA	10
MILITARY	
ARMY	1
USAF	91
USNAVY	17
MARINE CORPS	4
ANG	7
OTHER	15
PRIVATE	72
UNIVERSITY/RESEARCH	19
USDA	77
	382

**BIRD STRIKE COMMITTEE
USA/CANADA**

**ROSTER
OF
ATTENDEES**

**Sacramento, California
October 21-24, 2002**

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Adam	Mark	Falcon Environmental Services	20595 Eigg Road	Alexandria	ON	K0C 1A0	Canada	613-525-9998	613-525-4233	info@falconvnvironmental.com
Agustin	Joseph	Manila International Airport Authority	MIAA-NAIA, IPT1	Passy	Metro Manila	1301	Philippines	6328-333-805		joseph1231@pacific.net
Alegre	Alvin	USAF	7290 8th Street	Hill AFB	UT	84056	USA	801-777-2932	801-777-6269	alvin.alegre@hill.af.mil
Allan	John	Central Science Laboratory	Bird Strike Avoidance Team, Sand Hutton	York		YO41 1LZ	UK	44-1904-462210	44-1904-462111	j.allan@cscl.gov.uk
Amaral	Jandrisson	Brazilian Civil Aviation Department	Rua Santa Luzia, 651-10th Andar-Sala	Rio de Janeiro	Rio de Janeiro	20030040	Brazil	5521-3814-6985	5521-2544-1007	gurgel@dac.gov.br
Arnold	Paul	Dept. of National Defence-Canada	15 Wing Moose Jaw, P.O. Box 5000	Moose Jaw	SK	S6H 7Z8	Canada	306-694-2222	306-694-2813	arnold.pe@forces.ca
Atkinson	Richard		Faraday House, 38 Poole Road	Westbourne	Bournemouth	BH49DW	UK	44-1202-765317	44-1202-665363	
Atwell	Sheila	Air National Guard	1101 Grade Lane	Louisville	KY	40213	USA	502-364-9474	502-364-9605	sheila.atwell@kylouis.ang.af.mil
Avery	Michael	USDA, APHIS, Wildlife Services	2820 E. University Avenue	Gainesville	FL	32641	USA	352-375-2229	352-377-5559	michael.lavery@aphis.usda.gov
Badham	Andrew	BAA Gatwick Airport	8th Floor South Roof Office Block	West Sussex		RH16 0NP	UK	44-1293-50-3885	44-1293-50-5093	andrew_badham@baa.com
Baker	Clarke	USDA, APHIS, Wildlife Services	36704 Waco Road	Shawnee	OK	74801	USA	405-214-6717	405-525-5951	john.c.baker@inkster.af.mil
Baldwin	Brian	USAF, 20 FW	517 Lance Avenue, Suite 220	Shaw AFB	SC	29152	USA	803-895-1971	803-895-1987	brian.baldwin@shaw.af.mil
Ball	Dave	Vancouver International Airport Authority	P.O. Box 23750 APO	Richmond	BC	V7B 1Y7	Canada	604-303-3508	604-232-6244	dave.ball@yvr.ca
Ballinger	Ken	Arkion Life Sciences/Flight Control	3521 Silverside Road	Wilmington	DE	19810	USA	302-695-5781	302-695-5763	help@flightcontrol.com
Barnett	Dale	Safe Air Services LLC	1109 Thornton Street	Elkhart	IN	46514	USA	574-596-8457		safeairmaturity@aol.com
Barrieault	Mark	U.S. Army	E Co. 305th MI	Fort Huachuca	AZ	85613	USA	520-459-6868		mark.barrieault@hwa.army.mil
Bastos	Luiz Claudio	Brazilian Civil Aviation Department	CENIPA, SHIS, QI 05	Rio de Janeiro	Rio de Janeiro	20030040	Brazil	55-61-365-1008	55-61-365-1004	sed@cenipa.aer.mil.br
Battistoni	Valter	ENAC, Bird Strike Committee Italy	Aeroporto Civile Alghero	Alghero		07040	Italy	390-799-35039	390-799-35043	v.battistoni@enac.rupa.it
Beach	Robert	USDA, APHIS, Wildlife Services	4600 Kietzke Lane, Bldg. O, Suite 260	Reno	NV	89502	USA	775-784-5081	775-784-5874	robert.h.beach@aphis.usda.gov
Bean	Dianne	Embry-Riddle Aeronautical University	3200 Willow Creek Road	Prescott	AZ	86301	USA	928-777-3945	928-777-6988	beand@erau.edu
Beason	Robert	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	
Beiger	Michael	USDA, APHIS, Wildlife Services	EAD, PSC Box 8006, Rifle Range Road	MCAS Cherry Point	NC	28533	USA	252-466-4964	252-466-2000	begiermj@cherrypoint.usmc.mil
Berry	Vern	Evergreen Aviation	3850 Three Mile Lane	McMinnville	OR	97128	USA			vern.berry@evergreenaviation.com
Bitebekezi	Gloria	Civil Aviation Authority-Uganda	P.O. Box 5536	Kampala	Uganda		Uganda	256-41-7745-8598	256-41-321-401	gloriakirabo@yahoo.com
Blacklock	Bruce	Phoenix Agritech	P.O. Box 10	Turo	NS	B2N 5B6	Canada	902-662-2666	902-662-2888	phoenix@fox.nsn.ca
Blackwell	Bradley	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	bradley.f.blackwell@aphis.usda.gov
Blake	Terry	USAF	1113 Herman Avenue	Corapolis	PA	15108	USA	412-474-8580	412-474-8329	ces911pglt@aol.com
Bledsoe	Craig	Air Line Pilots Association (FedEx)	18811 Jamie Drive	Eagle River	AK	99577	USA	907-694-4730	907-696-4730	craig_bledsoe@ak-prepared.com
Borchert	Nick	USDA, APHIS, Wildlife Services	1800 Glenn Highway, Suite 12	Palmer	AK	99645	USA	907-745-0871	907-745-0872	nicholas.j.borchert@aphis.usda.gov
Bosques	Hector	USAF, HQ PACEF	105 12th Street	Honolulu	HI	96818	USA	808-449-8638	808-448-4214	hector.bosques@hickam.af.mil
Bowie	Robin	Maryland Aviation Administration	P.O. Box 8766	BWI Airport	MD	21240	USA	410-859-7103	410-859-5440	rbowie@bwiairport.com
Bowman	Brian	USAF	113 Jupiter Street	Sheppard AFB	TX	76311	USA	940-676-5000	940-676-4698	brian.bowman@sheppard.af.mil
Brenkert	Eric	USAF Academy	15633 Laguna Drive	Monument	CO	80132	USA	719-333-9306	718-333-3332	eric.brenkert@usafa.af.mil
Bridges	John	USAF, 347 RQW	29 South Boulevard	Avon Park AFB	FL	33825	USA	863-452-4254	452-863-4221	john.bridges@avonpark
Briggs	Richard	USAF Reserve, 94th AW	1477 Mimosa Dr., Bldg. 737, Suite 103	Dobbins AFB	GA	30069	USA	678-655-5051	678-655-5747	richard.briggs@dobbins.af.mil
Brown	Susan	USAF, Flight Safety	12811 Cheval Court	Upper Marlboro	MD	20772	USA	301-981-5806	301-821-4201	susan.brown@andrews.af.mil
Bruggers	Richard	USDA, APHIS, Wildlife Services	4101 LaPorte Avenue	Fort Collins	CO	80521	USA	970-266-6036	970-266-6040	richard.j.bruggers@usda.gov
Bryson	Andrew	Electrobraid Fence Limited	1021 Beaufort Avenue	Halifax	NS	B3H 3Y1	Canada	902-422-6678	902-422-0094	dbryson@electrobraid.com
Buckman	Arthur	USAF, HQ PACAF/CEV	25 E. Street, Suite D306	Hickam AFB	HI	96853	USA	808-449-9695	808-448-4209	arthur.buckman@hickam.af.mil
Buhl	Norman	USAF, 9th Reconnaissance Wing Flight Safety	19501 Edison Avenue	Beale AFB	CA	95903	USA	530-634-8873	530-634-9345	bulhni@beale.af.mil
Burgess	Joel	Kent County Dept. of Aeronautics	5500 44th Street	Grand Rapids	MI	49512	USA	616-233-6034	616-233-6025	jburgess@grt.org

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Burin	Jim	Flight Safety Foundation	601 Madison Street, Ste. 300	Alexandria	VA	22314	USA	703-739-6700	703-739-6708	
Burke	Carl	Sacramento County Airport System	7201 Earhart Drive	Sacramento	CA	95837	USA	916-874-0757	916-874-0728	burkec@saccounty.net
Burns	Jeff	Straughan Environmental Services	3905 National Dr., Ste. 370	Burtonsville	MD	20866	USA	301-989-3265	301-989-3271	recepti@sscenviro.com
Burst	Tom	U.S. Navy	P.O. Box 190010	North Charleston	SC	29419	USA	843-820-5590	843-818-6322	burstt1@e1deouth.navy.mil
Burton	Valerie	USDA, APHIS, Wildlife Services	1860 W. Alexander Drive	West Valley City	UT	84119	USA	801-975-3815	801-975-3320	
Butchko	Pete	USDA, APHIS, Wildlife Services	2803 Jolly Road, Suite 160	Okemos	MI	48864	USA	517-336-1928	517-336-1934	peter.h.butchko@aphis.usda.gov
Caballero	Manissa	Spawar Systems Center	53475 Strother Road	San Diego	CA	92152	USA	619-553-5834	619-553-6305	manissa@spawar.navy.mil
Campolucci	Gabriele	Aeroporto di Genova	Aeroporto C. Colombo	Genova	GE	16154	Italy	39-010-601-5480	39-010-601-5483	campolucci@airport.genova.it
Canada	Mike	Goosedog.com	221 E. Cherry Lane	Coalinga	CA	93210	USA	559-935-8309		canadaybc@sonemain.com
Canfield	Mary	U.S. Navy	NFESC, 1100 23rd Avenue	Port Hueneme	CA	93043	USA	805-982-1231	805-982-3481	canfieldm@nfwesc.navy.mil
Cannon	Thomas	USAF	97 AMW/SE, 100 Inez Blvd., Ste. 3	Altus	OK	72523	USA	580-481-7289	580-481-5928	thomas.cannon@altus.af.mil
Carlson	Michael	MEC Environmental Consulting	1003 Amelia Avenue	Royal Oak	MI	48073	USA	810-585-3800	810-585-8404	meccec@comcast.net
Carrillo	Christopher	USDA, APHIS, Wildlife Services	9380 Bond Ave., Suite A	El Cajon	CA	92021	USA	619-561-3752	619-561-3862	chris.d.carrillo@aphis.usda.gov
Carter	Nicholas	Border Collie Rescue Inc.	886 State Route 26	Melrose	FL	32666	USA	352-473-0100	352-473-6459	birdstrike@bcorescue.org
Caskey	Dennis	USAF, 92 ARW/SE	1 E. Bong St., Bldg. 2285, Suite 125	Fairchild AFB	WA	99011	USA	509-247-2142	509-247-5622	dennis.caskey@fairchild.af.mil
Casteel	Larry	USAF	121 Acreview Drive	Goldsboro	NC	27530	USA	919-722-4229	919-722-4086	larry.casteel@scymourjohnson.af.mil
Cepak	Jon	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	jon.d.cepak@aphis.usda.gov
Champoux	Gilles	National Defence	101 Colonel By Dr./PCBN	Ottawa	ON	K1A0K2	Canada	613-995-7008	613-995-1031	champoux_gj@forces.com
Chipman	Richard	USDA, APHIS, Wildlife Services	1930 Route 9	Castleton	NY	12033	USA	518-477-4837	518-477-4899	richard.b.chipman@aphis.usda.gov
Chirivi	Carlos	USAF, 12 CES/CEV	1651 5th Street West	Randolph AFB	TX	78150	USA	210-652-4668	210-652-3685	carlos.chirivi@randolph.af.mil
Christensen	Bill	USAF	4375 Chidlaw Road	Wright Patterson AFB	OH	45433	USA	937-257-8465	937-904-1064	william.christensen@wpafb.af.mil
Christopherson	Kirsten	USAF, Beale Air Force Base	6601 B. Street	Beale AFB	CA	95903	USA	530-634-2643	530-634-2845	kirsten.christopherson@beale.af.mil
Chu	William	PAmERE, LLC	884 Morgan Avenue	Schenectady	NY	12309	USA	518-346-1986	518-374-9290	wrlchu@msn.com
Clark	Gilbert	Louis Armstrong International Airport	P.O. Box 200041	New Orleans	LA	70141	USA	504-464-2672	504-463-1065	gilbertC@flymny.com
Cleary	Edward	FAA	800 Independence Avenue, SW	Washington	DC	20591	USA	202-267-3389	202-267-5383	ed.cleary@faa.gov
Cleland	Matt	USDA, APHIS, Wildlife Services	7333 World Way West	Los Angeles	CA	90045	USA	310-646-6638	310-641-8949	matthew.cleland@aphis.usda.gov
Colunga	Magdalena	Aeropuertos y Servicios Auxiliares	Av. 602, No. 161	Mexico City	DF	15620	Mexico			
Cooke	Mike	World Bird Sanctuary	125 Bald Eagle Ridge Road	Valley Park	MO	63088	USA	630-861-3225	630-861-3240	michaelcooke@aol.com
Coolhan	Craig	USDA, APHIS, Wildlife Services	3419A Arden Way	Sacramento	CA	95825	USA	916-979-2675	916-979-2680	craig.c.coolhan@aphis.usda.gov
Cooper	Jim	University of Minnesota	104 Hodson Hall, 1980 Folwell Avenue	St. Paul	MN	55108	USA	612-644-6206	612-625-5299	jac@jfw.umn.edu
Corley	Eddie	USAF, 6 OSS/OSA-BASH	7719 Hangar Loop Drive	MacDill AFB	FL	33621	USA	813-828-3981	813-828-1771	eddie.corley@macdill.af.mil
Coryell	Kevin	U.S. Navy, NAS Corpus Christi, Base Ops	5605 Les Parke Street	Corpus Christi	TX	78414	USA	361-961-4960	361-961-3437	kevin.coryell@nas.navy.mil
Cote	Chris	USAF Reserve, Safety	202 Liberty Way	Dover AFB	DE	19902	USA	302-677-3812	302-677-2942	pamela.withrow@dover.af.mil
Cowan	Eric	USDA, APHIS, Wildlife Services	P.O. Box 377	Duke	OK	73532	USA	580-481-7233	580-481-5928	
Crenshaw	Steve	Precise Flight Inc.	63120 Powell Butte Road	Bend	OR	97701	USA	541-382-8684	541-388-1105	stevec@preciseflight.com
Crisp	Howard	UPS	1400 N. Hurstbourne Parkway	Louisville	KY	40223	USA	502-329-6424	502-329-6550	h2hlc@ups.com
Cristiano	Jim	Bird Gard	P.O. Box 1659	Sisters	OK	97759	USA	541-549-0205	541-549-5286	
Crowe	Sam	USDA, APHIS, Wildlife Services	P.O. Box 59	Casper	WY	82602	USA	307-261-5336		
Cruddi	Attila	Military Aviation Authority	P.O. Box 25	Budapest		H-1885	Hungary	361-391-3769	361-391-3774	hmkh@hlm.gov.hu
Cushman	Curt	USAF	201 Liberty Way	Dover AFB	DE	19901	USA	302-677-2140	302-677-2144	curt.cushman@dover.af.mil
Dale	Ken	Air National Guard	1011 Gagel Avenue	Louisville	KY	40216	USA	502-366-4394		kenneth.dale@kylou.ang.af.mil

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Davenport	Phillip	USAF, HQ AF Flight Standards Agency	1535 Command Drive, Suite D307	Andrews AFB	MD	20762	USA	240-857-4365		phillip.davenport@andrews.af.mil
Davis	ID	U.S. Navy, NAS JRB Fort Worth	1215 Depot Avenue	Fort Worth	TX	76127	USA	817-787-6480	817-780-6486	
de Lorimer	Diane	Sutton Ag Enterprises, Inc.	746 Vertin Avenue	Salinas	CA	93901	USA	831-422-9693	800-482-4240	dianesuttonag@earthlink.net
Dean	Thomas	USAF	PSC 42, Box 336	APO	AA	34042	USA			thomas.dean@jtfb.southcom.mil
Deardorff	Lynn	FAA	1601 Lind Ave., SW, Ste. 315	Remton	WA	98055	USA	425-277-1621	425-227-1600	lynn.deardorff@faa.gov
DeFusco	Dona	BASH Inc.	5010 Lanagan Street	Colorado Springs	CO	80919	USA	719-264-8420	719-264-8420	bashincdonna@aol.com
DeFusco	Russell	BASH Inc.	5010 Lanagan Street	Colorado Springs	CO	80919	USA	719-264-8420	719-264-8420	birdmannuss@aol.com
Demas	Pete	USDA, APHIS, Wildlife Services	174 S. Ost.	Lincoln	CA	95648	USA	916-874-0501		pete.e.demas@aphis.usda.gov
Denzer	Terry	Bird Gard	P.O. Box 1659	Sisters	OR	97759	USA	541-549-0205	541-549-5286	idenzer@birdgard.com
Devere	James	USAF Reserve	1051 Fairchild Street	Willow Grove	PA	19090	USA	215-443-1094	215-443-1956	james.devere@willowgrove.af.mil
Dickerson	Frank	NAS Patuxent River	6905 Tracey Court	Gloucester	VA	23601	USA	301-342-3201		
Dickey	Archie	Embry-Riddle Aeronautical University	3200 Willow Creek Road	Prescott	AZ	86305	USA	928-777-3927	928-777-3827	dickeya@erau.edu
Dobson	Joseph	Airfield Turf	8088 Montview	Montreal	QB	H4P2L7	Canada	514-340-9311	514-340-9374	
Dogan	Robert	Air National Guard, HQ, ANG/CEVP	3500 Fetchet Avenue	Andrews AFB	MD	20762	USA	301-836-8859	301-836-8139	robert.dogan@ang.af.mil
Dolbeer	Richard	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	richard.a.dolbeer@aphis.usda.gov
Donalds	Tom	USAF, 4th Fighter Wing	131 Gasper Court	Clayton	NC	27520	USA	919-722-2118	919-722-2462	thomas.donalds@seymourjohnson.af.mil
Dove	Carla	Smithsonian Institution	P.O. Box 37012, NHB E-610	Washington	DC	20013	USA	202-357-2334	202-633-8084	dove.carla@imnh.si.edu
Dowlin	Renee	Oakland International Airport	One Airport Drive, Box 45	Oakland	CA	94621	USA	510-563-2884	510-569-9017	
Duncan	Karen	USDA, APHIS, Wildlife Services	2800 North Lincoln Blvd.	Oklahoma City	OK	73105	USA	405-521-4039	405-525-5951	
Eisner	Christine	U.S. Navy	BFA Northeast, 10 Industrial Hwy, MS82	Lester	PA	19113	USA	610-595-0567	610-595-0555	cisnercc@efane.navy.mil
Ellea	Michael	USDA, APHIS, Wildlife Services	2500 S. High School Road, Suite 100	Indianapolis	IN	46241	USA	317-487-5381	314-487-5155	melsea@baai.com
Enyart	Mark	USAF	3400 15th Street, W.	Rosamond	CA	93560	USA	661-277-2222	661-277-5544	mark.enyart@edwards.af.mil
Eschenfelder	Paul	Air Line Pilots Association	16326 Cranwood	Spring	TX	77379	USA	281-370-3925	281-370-3925	eschenfelder@compuserve.com
Fearheller	Chris	World Bird Sanctuary	125 Bald Eagle Ridge Road	Valley Park	MO	63088	USA	636-861-3225	636-861-3240	
Febbo	John	Sacramento International Airport		Sacramento	CA		USA			
Feist	Jerry	USDA, APHIS, Wildlife Services	529 Centerville Street	Greensboro	AL	36744	USA	334-624-8711	334-624-8606	jerry.g.feist@aphis.usda.gov
Felix	Todd	USDA, APHIS, Wildlife Services	Logan Intl Airport, Airport Facility 2	East Boston	MA	02128	USA	617-561-1868	617-568-3656	tfelix@massport.com
Fordham	Wayne	USAF	2660 Ferol Lane	Lynn Haven	FL	32444	USA	850-283-6465		
Foster	Michael	USDA, APHIS, Wildlife Services	9134 W. Black Eagle	Boise	ID	83706	USA	208-378-5077		
Francouer	Laura	Port Authority of NY and NJ	JFK International Airport, Bldg. 14	Jamaica	NY	11430	USA	718-244-3773	718-244-3777	lfrancoe@panynj.gov
Gardiner	James	U.S. Dept. of Energy	5316 Magenta Court	Las Vegas	NV	89108	USA	702-648-4432	702-794-5559	quickdog@aol.com
Gates	Mark	USAF, Barksdale AFB	6141 Range Road	Barksdale AFB	LA	71110	USA	318-456-1963	318-456-1321	mark.gates@barksdale.af.mil
Gendron	Ronald	USAF	PSC 42, Box 336	APO	AA	34042	USA			ronald.gendron@jtfb.southcom.mil
Gilbert	Mallory	USAF Reserve	206 Scarborough Drive	Cheswick	PA	15024	USA	412-767-5852	412-767-5862	mugilenv@aol.com
Glass	John	Philadelphia International Airport	Division of Aviation, Terminal E	Philadelphia	PA	19155	USA	215-937-6916	215-937-6873	john.glass@phila.gov
Godinez	Esteban	ICAO Technical Cooperation Mission	Aeropuerto Marcos A. Gelabert	Panama			Panama	507-315-0399	507-315-0399	panmibis@hotmail.com
Gonzales	Danielle	USAF	405 S. Doolittle Avenue	Fairchild AFB	WA	99011	USA	509-247-2424	509-247-3722	leonard.burns@fairchild.af.mil
Gonzalvo	Allan	Manila International Airport Authority	Ninoy Aquino International Airport	Passay City	Metro Manila	1301	Philippines	632-833-3805	632-833-3805	gonzy6395@yahoo.com
Gordon	Sharon	Port of Portland	7000 NE Airport Way	Portland	OR	97218	USA	503-460-4179	503-460-4588	gordos@portplid.com
Gorenzel	Paul	University of California	One Shields Avenue	Davis	CA	95616	USA	530-752-2263	530-752-4154	wagorenzel@ucdavis.edu
Gosser	Allen	USDA, APHIS, Wildlife Services	1930 Route 9	Castleton	NY	12033	USA	518-477-4837	518-477-4899	allen.l.gosser@aphis.usda.gov

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Granger	Matt	USAF, BASH Team	9700 Ave G, SE, Suite 266, Bldg. 24499	Kirtland AFB	NM	87117	USA	505-846-2864	505-846-0684	mat.granger@kafb.af.mil
Gray	John	URS Corporation	130 Robin Hill Road, Suite 100	Santa Barbara	CA	93117	USA	805-964-6010	805-694-0259	john_gray@urscorp.com
Gray	Shelley	USDA, APHIS, Wildlife Services	4th Fighter Wing/SEF, 1980 Jabara Ave.	Seymour Johnson AFB	NC	27531	USA	919-722-4223	919-722-4086	shelley.gray@seymourjohnson.af.mil
Griffin	Marie	USDA, APHIS, Wildlife Services	P.O. Box 81866	Lincoln	NE	68501	USA	402-434-2340	402-434-2330	
Griggs	Hope	Air National Guard	18860 E. Breckenridge Ave., Stop 80	Buckley AFB	CO	80011	USA	303-677-9042	303-677-9134	hope.griggs@cobuck.af.mil
Gustad	Kirk	USDA, APHIS, Wildlife Services	2869 Via Verde Drive	Springfield	IL	62703	USA	217-241-6700	217-241-6702	kirk.e.gustad@aphis.usda.gov
Hager	Thomas	USAF, Travis AFB	119 Georgetown Drive	Vacavine	CA	95687	USA	707-424-1115	707-424-1104	thomas.hager@travis.af.mil
Hallett	Carole	Pacific Habitat Services, Inc.	9450 SW Commerce Circle, Suite 180	Wilsonville	OR	97070	USA	503-570-0800	503-570-0855	bonneyh@aol.com
Halpin	Tricia	FAA, Airport Certification	2300 E. Devon Avenue	Des Plaines	IL	60018	USA	847-294-7013	847-294-7036	tricia.halpin@faa.gov
Hardy	Clark	Wildlife Control Technology, Inc.	2501 N. Sunnyside Avenue	Fresno	CA	93727	USA	800-235-0262	559-490-2260	clark@wildlife-control.com
Harmon	Lisa	Straughan Environmental Services	3905 National Dr., Ste. 370	Burtonsville	MD	20866	USA	301-989-3265	301-989-3271	recept@sesenviro.com
Harmon	Tim	USAF, 940 ARW/SE	19395 Edison Avenue, Bldg. 11606	Beale AFB	CA	95903	USA	530-634-1933	530-634-1864	timothy.harmon@beale.af.mil
Haughn	Darron	USAF, 21 SW/SEF	775 Loring Avenue, Suite 215	Peterson AFB	CO	80914	USA	719-556-6345	719-556-4004	darron.haughn@peterson.af.mil
Henshaw	Brian	Gartner Lee Limited	140 Renfrew Drive., Suite 102	Markham	ON	L3R 6B3	Canada	905-477-8400	905-477-1458	bhenshaw@gartnerlee.com
Hersteinsson	Pall	University of Iceland, Dept. of Biology	Grensasvegur 11	Reykjavik	IS-108	Iceland		354-525-4608	354-525-4281	pher@hi.is
Heuser	Chad	USDA, APHIS, Wildlife Services	14921 W. Caribbean Lane	Surprise	AZ	85379	USA	602-870-2081	602-870-2951	chad.heuser@luke.af.mil
Himmen	Kurt	USAF, Wing Safety	7046 N. Fighter Country Ave.	Luke AFB	AZ	85309	USA	623-856-6941	623-856-3464	kurt.himmen@luke.af.mil
Hodge	Gene	USAF, 12 FTW Safety	225 A Street East	Randolph AFB	TX	78150	USA	210-487-2224	210-487-5587	gene.hodge@randolph.af.mil
Holly	Chris	Clickairport	Faraday House, 38 Poole Road	Westbourne	Bournemouth	BH49DW	UK	44-1202-765317	44-1202-665363	
Holmes	Robert	USAF, 60 CES/CEV	580 Hickam Avenue, Bldg. 246	Travis AFB	CA	94535	USA	707-424-3897	707-424-5105	bob.holmes@travis.af.mil
Horton	Nigel	Scarecrow Bio-Acoustic Systems Inc.	P.O. Box 66	Uckfield	East Sussex	TN22 3ZR	UK	44-1825-732601	44-1825-732730	sales@scarecrowbio-acoustic.co.uk
Hovan	Michel	FAA	William J. Hughes Technical Center	Pomona	NJ	08405	USA	609-485-5552	609-485-4845	michel.hovan@faa.gov
Howard	Howdy	University of California	Wildlife, Fish & Conservation Biology	Davis	CA	95616	USA			
Humphrey	Mack	FAA, Alaskan Region Airports Division	222 W. 7th Ave., #14, AAL-804	Anchorage	AK	99513	USA	907-271-5444	907-271-2851	mack.humphrey@faa.gov
Humphrey	John	USDA, APHIS, Wildlife Services	2820 E. University Avenue	Gainesville	FL	32641	USA	352-375-2229	352-377-5559	john.s.humphrey@aphis.usda.gov
Hurley	Coleridge	Puerto Rico Ports Authority	P.O. Box 37250	San Juan	PR	00937	USA	787-791-1011	787-791-2155	safetyerie@hotmail.com
Jackson	Wayne	Transport Canada	2200 Elder Street	Ottawa	ON	K2B 6N1	Canada	613-728-3469	613-728-7950	jacksonw@travel-net.com
Jaczinski	James	USAF, HQ AMC/SEF, Flight Safety	510 POW-MIA Dr., Rm. E119	Scott AFB	IL	62225	USA	618-229-0935	618-229-0230	james.jaczinski@scott.af.mil
Jacn	Jose del C.	Panama Civil Aeronautical Authority	Aeropuerto Internacional de Tocumen	Panama			Panama	507-238-4322	507-315-0399	panmbis@hotmail.com
Jager	Sietse	CAA Netherlands, Div. Aerodromes & Airspace	P.O. Box 575	2130 AN	Hoofddorp		Netherlands	3123-566-3142	3123-566-3000	sietse.jager@uuwv.nl
James	Gerald	Air National Guard	140 S. Aspen Street, Stop 22	Buckley AFB	CO	80011	USA	303-677-9738	303-677-9976	gerald.james@cobuck.af.mil
Jennings	Karen	USAF	9277 Willow Grove	Camden	DE	19934	USA	302-677-6171		
Johnson	Gerald	USAF, 92 CES/CEVN	100 W. Ent Street	Faithchild AFB	WA	99011	USA	509-247-8207	509-247-4858	gerald.johnson@fairchild.af.mil
Jones	Mark	USAF, MacDill Air Force Base	14515 Diplomat Drive	Tampa	FL	33613	USA	813-828-2480	813-828-6794	mark.jones.1@macdill.af.mil
Jonsson	Gudmundur	Environmental Division, Naval Air Station	PSC 1003, P.O. Box 23	FPO	AE	09728	Iceland	354-425-2852	354-425-2948	gog@naskel.fnavy.mil
Joseph	Reed-Joseph	International Co.	P.O. Box 894	Greenville	MS	38702	USA	800-647-5554	662-335-8850	jbj3@reedjoseph.com
Juliano	Steve	San Francisco Intl. Airport	Airfield Operations	San Francisco	CA	94128	USA	650-821-3355	650-821-4670	steve.juliano@flysfo.com
Kassinis	William	USAF, 88 OSS/OSA	5291 Skel Avenue, Room 200	Wright Patterson AFB	OH	45433	USA	937-257-6206	937-257-1691	
Katsaris	Steve	USAF, 89 A W Flight Safety	5902 Mount Eagle Drive, #603	Alexandria	VA	22303	USA	703-329-1418	301-981-4201	steve.katsaris@andrews.af.mil
Kelly	T. Adam	Geo-Marine, Inc.	3160 Airport Road, Suite 22A	Panama City	FL	32405	USA	850-913-8003	850-913-9582	bashbam@aol.com
Kelly	Tom	Dept. of Zoology & Animal Ecology	National University of Ireland Cork	Cork			Ireland			

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Kemp	Gerry	Prism Environmental Consulting Service	#31, 11105 9th Ave.	Edmonton	AB	T6J 6Z4	Canada	780-437-1920	780-432-4512	gakemp@shaw.ca
Key	Gerry	Computer Sciences Corporation	4045 Hancock Street	San Diego	CA	92110	USA	619-553-3320	619-553-6305	key@nosc.mil
Kidd	Tyrone	USAF, 354th Operations Support Squadron	1215 Flightline Avenue	Edison AFB	AK	99702	USA	907-377-3233	907-377-3562	tyrone.kidd@eielson.af.mil
Kirkwood	Mathew	Safe Air Services LLC	216 Tan Tara	Stillwater	OK	74074	USA	405-744-7383	405-744-9709	kirkwood@okstate.edu
Kiss	Lajos	Military Aviation Authority	P.O. Box 25	Budapest			Hungary	361-391-3766	361-391-3774	hmkh@hm.gov.hu
Klein	Lawrence	Wave Band	375 Van Ness Avenue, Suite 1105	Torrance	CA	90501	USA	310-212-7808	310-212-7726	lklein@waveband.com
Klope	Matthew	U.S. Navy	1115 W. Lexington Street, Bldg. 103	Oak Harbor	WA	98278	USA	360-257-1468	360-257-8767	klopmw@efanw.navy.mil
Knauer	Bob	Flight Control Representative	2331 San Benito Court	Claremont	CA	91711	USA	909-621-6677	909-621-3839	ebh2@ix.netcom.com
Knight	James	USAF HQ Europe	HQ USAF/DOYF, Unit 3050, Box 15	APO	AB	09094	USA	4963-7147-58395	4963-7147-9653	james.knight@ramstein.af.mil
Knudson	Ronald	USAF, Little Rock Air Force Base	314 A/W/SE, 1260 Thomas Ave., Ste. 107	Little Rock AFB	AR	72099	USA	501-987-7715	501-987-8140	ronald.knudson@littlerock.af.mil
Kok	Ordino	University of the Free State	Dept. of Zoology, P.O. Box 339 UFS	Bloemfontein	SA	9300	South Africa	2751-401-2489	2751-448-8711	kokob@sci.uovs.ac.za
Kot	Christopher	USAF	1113 Herman Avenue	Corapolis	PA	15108	USA	412-474-8580	412-474-8329	
Kroll	Travis	USAF Reserve	1051 Fairchild Street	Willow Grove	PA	19090	USA	215-443-1094	215-443-1956	travis.kroll@willowgrove.af.mil
Lahser	Carl	USAF Air Education & Tm/g Command	HQ AETC/CEVN, 266 F Street West	Randolph AFB	TX	78150	USA	210-652-3959	210-652-2542	carl.lahser@randolph.af.mil
Lampman	Richard	Electrobraid Fence Limited	1021 Beaufort Avenue	Halifax	NS	B3H 3Y1	Canada	519-688-8330	519-765-3367	rlampman@electrobraid.com
Lardarello	Steven	USAF, 512 ALCF	202 Liberty Way	Dover AFB	DE	19902	USA	302-677-6145	302-677-3725	steve.lardarello@attws.com
Larsen	Joergen Lolk	Danish Civil Aviation Administration	Ellebjergvej 50	Copenhagen SV	DK	2450	Denmark	45-3618-6250	45-3618-6001	jola@slv.dk
Lata	Joe	Becker Underwood	801 Dayton Avenue	Ames	IA	50010	USA	515-232-5907	515-232-5961	
Hosoda	Joe	Becker Underwood	801 Dayton Avenue	Ames	IA	50010	USA	515-232-5907	515-232-5961	
Latorne	Terrence	USMC, 2nd Marine Air Wing	PSC Box 8016	Cherry Point	NC	28533	USA	252-466-7132	252-466-2088	latorne@2nawcp.usmc.mil
Laws	Margaret	U.S. Fish & Wildlife Service	Migratory Bird Management Office	Anchorage	AK	99503	USA	907-786-3693	907-786-3641	
LeBoeuf	Eugene	USAF, BASH Team	9700 Ave G, SE, Ste. 266, Bldg. 24499	Kirtland AFB	NM	87117	USA	505-846-5679	505-846-0684	eugene.leboeuf@kafb.af.mil
Ledbetter	John	City of Santa Barbara	530 Garden Street	Santa Barbara	CA	93101	USA	805-564-5502	805-564-5477	jledbetter@ci.santa-barbara.ca.us
Leeman	Thomas	Environmental Science Associates	8950 Cal Center Drive, Suite 300	Sacramento	CA	95826	USA	916-564-4500	916-564-4501	lleeman@essassoc.com
Lewis	Howell	USAF, 51st Fighter Wing Safety Office	5362 Osan Air Base, Republic of Korea	APC	AP	96266	USA	8231-661-4747		howell.lewis@osan.af.mil
Lichlyer	Troy	USDA, APHIS, Wildlife Services	228 Randall Drive	Midwest City	OK	73110	USA	405-739-0252	405-525-5951	troy.lichlyer@tinker.af.mil
Linnell	Mike	USDA, APHIS, Wildlife Services	720 O'Leary Street NW	Olympia	WA	98502	USA	360-753-9884	360-753-9466	mike.a.linnell@aphis.usda.gov
Lions	Scott	USDA, APHIS, Wildlife Services	720 O'Leary Street NW	Olympia	WA	98502	USA	360-753-9884	360-753-9466	
Lockhart	James	USDA, APHIS, Wildlife Services	P.O. Box 122	Newata	OK	74048	USA	918-273-0135	405-525-5991	
Lombardo	Eric	USAF, 7th Bomb Wing/Safety	498 Alert Avenue	Dyess AFB	TX	79607	USA	915-696-3044	915-696-1784	eric.lombardo@dyess.af.mil
Long	William	FAA	P.O. Box 92007	Los Angeles	CA	90009	USA	310-725-3635	310-725-6849	william.long@faa.gov
Lott	John	FAA, Airport Certification	2300 E. Devon Avenue	Des Plaines	IL	60018	USA	847-294-7013	847-294-7036	john.lott@faa.gov
Louie	Elizabeth	FAA	15000 Aviation Blvd., Room 3024	Lawndale	CA	90261	USA	310-725-3636	310-725-6849	elizabeth.louie@faa.gov
Lucas	Jon	Reed-Joseph International Co.	15111 North Hayden, #545	Scottsdale	AZ	85260	USA	480-419-7341	480-419-7342	jonrws71@aol.com
Lynch	Jennifer	USDA, APHIS, Wildlife Services	12345 W. Alameda Pkwy, Ste. 210	Lakewood	CO	80228	USA	303-969-5775	303-969-5798	jennifer.a.lynch@usda.gov
MacKinnon	Bruce	Transport Canada	330 Sparks Street, Place de Ville	Ottawa	ON	K1A 0N8	Canada	613-990-0515	613-990-0508	mackinn@tc.gc.ca
Maguire	Shaun	Gespe Police, Inc.	P.O. Box 656	Howell	NJ	07731	USA			www.gespepoliceinc.com
Malling	Vik	USAF Reserve	31871 Leigh Lane	Temecula	CA	92591	USA	909-655-4406	909-655-4235	vik.malling@march.af.mil
Manansala	Enrico	Manila International Airport Authority	MIAA-NAIA, IPT1	Passay	Metro Mani	1301	Philippines	6328-333-805		
Marcus	Stan	South Africa Air Force	P.O. Box 794	Bedfordview		2008	South Africa	2711-828-0800	2711-828-0246	smarcus@global.co.za
Marley	Jeff	Margo Supplies Ltd.	P.O. Box 5400	High River	AB	T1V 1M5	Canada	403-652-1932	403-652-3511	janarley@margosupplies.com

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Marsh	Rex	Univ. of California, Wildlife, Fish & Conservation	One Shields Ave.	Davis	CA	95616	USA	530-753-3608		remarsh@ucdavis.edu
Marshall	John	Associated Opto-Electronics	307A S. Chapel Avenue	Alhambra	CA	91801	USA	626-451-6262	626-570-9746	westwind@gnille.com
Marshall	Rosemary	Associated Opto-Electronics	307A S. Chapel Avenue	Alhambra	CA	91801	USA	626-451-6262	626-570-9746	westwind@gnille.com
Martin	Chris	Sacramento County Airport System	7201 Earhart Drive	Sacramento	CA	95837	USA	916-879-0650	916-874-0728	martinc@gsacounty.net
Marx	Don	U.S. Navy, Oceana Naval Base	1003 D. Avenue	Virginia Beach	VA	23460	USA	757-421-8043	757-421-8136	marx@jpwcnorva.navy.mil
Mata	Oseas	USAF, Offutt AFB	P.O. Box 13072	Offutt AFB	NE	68113	USA	402-294-5845	402-232-4175	mataseas@offutt.af.mil
Matkovich	Carolyn	Geo-Marine, Inc.	3160 Airport Road, Suite 22A	Panama City	FL	32405	USA	850-913-8003	850-913-9582	cmatkovich@geo-marine.com
May	Chris	USAF, 437 AW	Bldg. 1600 SE, 102 E. Hill Blvd.	Charleston AFB	SC	29404	USA	843-963-5602	843-963-4030	christopher.may@charleston.af.mil
McBride	Devon	USDA, APHIS, Wildlife Services	2150 Centre Ave., Bldg. B, MS 3W9	Ft Collins	CO	80526	USA	970-494-7451	970-494-7455	michael.worlten@aphis.usda.gov
McCasland	Lance	Sacramento County Airport System	7201 Earhart Drive	Sacramento	CA	95837	USA	916-874-0470	916-874-0728	
McClinton	Theron	USAF	106 Hemlock Court	Yorktown	VA	23693	USA	757-764-3120	757-764-3313	theron.mcclinton@jangle.af.mil
McGrogan	Lawrence	U.S. Navy, Oceana Naval Base	1003 D. Avenue	Virginia Beach	VA	23460	USA	757-433-2151	757-433-2719	mcgroganl@jpwcnorva.navy.mil
McKeever	Camille	U.S. FWS, Migratory Bird Office	P.O. Box 709	Albuquerque	NM	87102	USA	505-248-7884	505-248-6674	McKeever_camille@fws.gov
McLaughlin	Scott	Applied Technologies, Inc.	1120 Delaware Avenue	Longmont	CO	80501	USA	303-684-8722	303-684-8773	scott@apptech.com
McTaggart	Scott	Electrobraid Fence Limited	1021 Beaufort Avenue	Halifax	NS	B3H 3Y1	Canada	519-643-6773	519-782-4324	smcaggart@electrobraid.com
Meehan	John	Greater Toronto Airports Authority	P.O. Box 6031, 3111 Connaught Drive	Toronto	ON	L5P 1B2	Canada	416-776-5597	416-776-3483	john.meehan@gtaa.com
Meehan	Shawn	USAF	400 Brennan Circle	Travis AFB	CA	94535	USA	707-424-1116	707-424-1104	michael.tison@travis.af.mil
Mendoza	Martin	USDA, APHIS, Wildlife Services	Stop 1402, Rm. 16248 14th & Independence	Washington	DC	20250	USA	202-720-2054	202-690-0053	martin.mendoza@usda.gov
Merrifield	Alan	California Nuisance Wildlife Control Operators	P.O. Box 90	Burlingame	CA	94011	USA	650-343-4380	650-343-4380	alanm99@aol.com
Merritt	Ron	Geo-Marine, Inc.	3160 Airport Road, Suite 22A	Panama City	FL	32405	USA	850-913-8003	850-913-9582	bashman@aol.com
Meunier	Marc	Transport Canada	700 Leigh Capreol-Zone 3D	Dorval	QB	H4Y 1G7	Canada	514-633-3847	514-633-3353	meunier@tc.gc.ca
Miarecki	Sandra	USAF, 19 AF/SE	73 Main Circle	Randolph AFB	TX	78150	USA	210-652-1989	210-652-2110	sandra.miarecki@randolph.af.mil
Milawon	Bodin	The Royal Thai Air Force	RTAF Hqtrs., Aviation Safety Division	Bangkok	Thailand	10210	Thailand	66-02-534-1362	66-02-534-1342	bodin27@hotmail.com
Miller	Terrance	USAF	PSC 19105	Edwards AFB	CA	93524	USA	661-277-2222	661-277-5544	terrance.miller@edwards.af.mil
Milaps	Derek	USDA, APHIS, Wildlife Services	3530 Oak Canyon Lane	Vacaville	CA	95688	USA	510-774-9647		derek.g.milaps@aphis.usda.gov
Miyashiro	Randy	U.S. Navy	850 Ticonderoga Ave., Suite 110	Pearl Harbor	HI	96860	USA	808-471-1171	808-471-1160	miyashiro@pwppearl.navy.mil
Moore	David	USMC Marine Corps Air Facility Quantico	2100 Rowell Road	Quantico	VA	22134	USA	703-784-1455		mooreda@hmx-1.usmc.mil
Moore	David	USAF, Travis AFB	400 Brennan Circle	Travis AFB	CA	94535	USA	707-424-5437	707-724-1104	david.moore@travis.af.mil
Moore	David	USAF, 439th Airlift Wing	100 Lloyd Street, Suite 102	Westover AFB	MA	01022	USA	413-557-3587	413-557-2099	david.moore@westover.af.mil
Moore	Kari	U.S. Navy	437 Huey Drive	Brunswick	ME	04011	USA	207-921-2772	207-921-2649	schank@nasb.navy.mil
Morse	George	Failure Analysis Service Technology, Inc.	2305 St. Bernard Drive	Pine Mountain	CA	93222	USA	800-657-5664	661-242-4910	george@fod.com
Muls	Laura	U.S. Navy, NBVC Point Mugu	311 Main Rd., Suite 1	Point Mugu	CA	93041	USA	805-989-3204	805-989-1011	muls@nhbc.navy.mil
Munro	Duncan	USAF, Air Combat Command	Hampton Harbor Centre, 2 Eaton Street	Hampton	VA	23669	USA	757-764-8819	757-764-8975	duncan.munro@jangle.af.mil
Naylor	Michael	Clickairport	Faraday House, 38 Poole Road	Westbourne	Bournemouth	BH49DW	UK	44-1202-765317	44-1202-665363	michael.naylor@clickairport.com
Neff	Richard	USMC, MAG-29, MCAS New River	PSC Box 21020, MCAS New River	Jacksonville	NC	28545	USA	910-449-7558	910-449-6320	neffr@zsmawr.usmc.mil
Newman	Allen	Embry-Riddle Aeronautical University	3200 Willow Creek Road	Prescott	AZ	86301	USA	928-777-3947		
Nottingham	Page	Sacramento County Airport System	6151 Freeport Blvd., Suite 177	Sacramento	CA	95610	USA	916-875-9035	916-428-2173	nottingham@gsacounty.net
Olexa	Thomas	USDA, APHIS, Wildlife Services	1 FW/SE 65 Sweeney Blvd.	Langley AFB	VA	23665	USA	757-764-5357	757-764-5358	thomas.olexa@jangle.af.mil
Ono	Mark	USDA, APHIS, Wildlife Services	3375 Koapaka Street, Suite H-420	Honolulu	HI	96819	USA	808-861-8575	808-861-8570	mark.s.ono@aphis.usda.gov
Orosz	Alex	United Airlines	SFOEP-Bldg. 84, San Francisco Intl. Airport	San Francisco	CA	94128	USA	650-634-2340	650-634-2315	alex.orosz@united.com
Osmeck	Steven	Sea-Tac International Airport	P.O. Box 68727	Seattle	WA	98168	USA	206-431-4453		osmeck@portseattle.org

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Ostrom	John	Minneapolis-St. Paul Intl. Airport	4300 Glumack Drive	St. Paul	MN	55111	USA	612-726-5780	612-726-5074	jostrom@mspmac.org
Oswalt	Brian	USAF, 319 Air Refueling Wing	501 Belmont Road	Grand Forks	ND	58205	USA	701-746-4001	701-747-3372	brian.oswalt@grandforks.af.mil
Oswald	Johann	Fed. Min. Transport, Innovation & Tech.	Radetzkystrasse 2	Vienna		1030	Austria	431-711-629910		johann.oswald@bmvil.gv.at
Owen	Bob	Sacramento County Airport System	7201 Earhart Drive	Sacramento	CA	95837	USA	916-874-0470	916-874-0728	owenb@saccounty.net
Owens	Rick	USDA, APHIS, Wildlife Services	920 Main Campus Dr., Suite 200	Raleigh	NC	27606	USA	919-716-5633	919-716-5659	rick.d.owens@aphis.usda.gov
Pacheco	Michael	USDA, APHIS, Wildlife Services	2224 W. Desert Cove, Suite 209	Phoenix	AZ	85029	USA	602-870-2081	602-870-2951	michael.a.pacheco@aphis.usda.gov
Parker	L. Howard	USAF Flight Safety	817 H Street, Room 203	Keesler AFB	MS	39534	USA	228-377-1900	228-377-7027	howard.parker@keesler.af.mil
Parker	Richard	Pratt & Whitney	400 Main Street, M/S 162-24	E. Hartford	CT	06108	USA	860-565-4386	860-565-1568	parkerrl@pwh.com
Parriott	Jack	USDA, APHIS, Wildlife Services	3419A Arden Way	Sacramento	CA	95825	USA	916-979-2675	916-979-2680	
Patterson	Brett	Vancouver International Airport Authority	P.O. Box 23750, Airport Postal Outlet	Richmond	BC	V7B 1Y7	Canada	604-276-6141	604-232-6152	brett.patterson@yvr.ca
Pellegrino	Antonio	Italian Air Force	V. le dell'Universite 4	Roma		00185	Italy			isv@aeronautica.difesa.it
Pennell	Christopher	AgResearch	P.O. Box 60, Gerald Street	Lincoln	Canterbury		New Zealand	643-983-3969	643-983-3913	
Pennix	Sieve	U.S. Navy	B-00982, NAWS China Lake	China Lake	CA	93555	USA	760-939-3238	760-939-2980	penixsl@navair.navy.mil
Perez	Ramon	USAF, 6 OSS/OSA-BASH	7719 Hangar Loop Drive	MacDill AFB	FL	33621	USA	813-828-3981	813-828-1771	ramon.perez@macdill.af.mil
Persson	Johnny	CAA Sweden	Luftfartsverket	Stockholm-Arlanda	Sweden	S-19045	Sweden	46-8-797-6619	46-8-5936-2075	johnny.persson@lfrv.se
Peurach	Suzanne	USGS, Patuxent Wildlife Research Ctr.	P.O. Box 37012, NHB, Rm. 378	Washington	DC	20013	USA	202-357-1865	202-357-1932	peurach.suzanne@nrmh.si.edu
Philiben	Scott	Precise Flight Inc.	63120 Powell Butte Road	Bend	OR	97701	USA	541-382-8681	541-388-1105	scott@preciseflight.com
Pineck	William	San Diego International Airport	P.O. Box 120488	San Diego	CA	92112	USA	619-686-8065	619-686-8165	wpineck@portofsanandiego.org
Pinos	Alistair	ICAO	999 University Street	Montreal	Quebec	H3C 5H7	Canada	514-954-8219	514-954-6759	apinos@icao.int
Pipas	Patty	USDA, APHIS, Wildlife Services	4101 LaPorte Avenue	Fort Collins	CO	80521	USA	970-266-6131	970-266-6138	
Pociecha	Michael	Port of Portland International Airport	8990 Earhart Road, #311	Oakland	CA	94621	USA	510-563-3917	510-569-3769	
Poggiali	Betsy	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	betsy.j.poggiali@aphis.usda.gov
Polillo	Albert	USDA, APHIS, Wildlife Services	Philadelphia Intl Airport, Div. Of Aviation	Philadelphia	PA	19153	USA	215-937-6851	215-937-6873	albert.m.polillo@aphis.usda.gov
Price	Becky	Arkion Life Sciences	3521 Silverside Road	Wilmington	DE	19810	USA	800-468-6324		
Ramage	Rex	USAF	1704 Chaput Drive	Bellevue	NE	68005	USA	402-731-9149	302-695-5763	rex.ramage@coffut.af.mil
Rapps	Michael	Rapps Engineering & Applied Science	821 South Durkin Drive	Springfield	IL	62704	USA			
Rapsys	Vid	Geese Police, Inc.	P.O. Box 875	Naperville	IL	60566	USA	630-548-9781	630-548-9258	goosecopvid@aol.com
Rardin	Andrew	Snohomish County Airport/Paine Field	3220 100th Street SW	Everett	WA	98204	USA	425-353-2110	425-355-9883	andrew.rardin@co.snohomish.wa.us
Read	Martin	USAF Reserve	19395 Edison Avenue, Bldg. 11606	Beale AFB	CA	95903	USA	530-634-1930	533-634-1864	martin.read@beale.af.mil
Reed	Julian	Rollis-Royce	P.O. Box 31	Derby	Derbyshire	DE248B5	UK	1332-244421	1332-246879	julian.reed@rollis-royce.com
Reilly	Keith	Transport Canada	4900 Yonge Street, Suite 400	Toronto	ON	M2N6A5	Canada	416-952-7254	416-952-0050	reillyk@tc.gc.ca
Renelt	Mark	Jet Blue Airways	2814 St. Cloud Oaks Drive	Valrico	FL	33694	USA	813-727-2009		mark.renelt@jetblue.com
Renwick	Patrick	Air National Guard	1100 S. Petercheff Street	Terre Haute	IN	47803	USA	812-877-5234	812-877-5141	patrick.renwick@interang.af.mil
Rickerhauser	Don	Northwest Airlines, Operational Safety	2600 Lone Oak Point	Eagan	MN	55121	USA	612-727-4019	612-727-9964	don.rickerhauser@nwa.com
Ritchie	Jeffery	USAF	97 AMW/SE, 100 Inez Blvd., Stu. 3	Altus	OK	72523	USA	580-481-7289	580-481-5928	jeffery.ritchie@altus.af.mil
Roberts	Phil	Sercio Aviation Services Inc.	3200 County Road #42	Windsor	ON	N9A6J3	Canada	519-969-9096	519-969-8827	philroberts@windSORairport.net
Robinson	Phillip	USDA, APHIS, Wildlife Services	2800 N. Lincoln Blvd.	Oklahoma City	OK	73105	USA	405-522-5465	405-525-5951	phillip.l.robinson@aphis.usda.gov
Robinson	Simon	Vancouver International Airport Authority	Box 23750	Richmond	BC	V7B1Y7	Canada	604-276-1408	604-276-6699	simon.robinson@yvr.ca
Rodchang	Niyom	The Royal Thai Air Force	RTAF Hqtrs., Aviation Safety Division	Bangkok	Thailand	10210	Thailand	66-02-534-1362	66-02-534-1342	ria.safety@hotmail.com
Rochlisberger	Dixie	BirdTec, Inc.	4074 155th Avenue	Hersey	MI	49639	USA	231-832-1943	231-832-0756	birdtec@yahoo.com
Rogers	Bill	U.S. Marine Corps	3313 Hedgerow Circle	New Bern	NC	28562	USA	252-466-5870	252-466-2000	

ATTENDEES AT BSC-USA/CANADA 2002

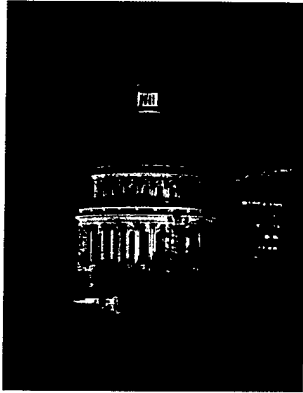
LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Rogers	Elizabeth	White Water Associates, Inc.	P.O. Box 27	Amasa	MI	49903	USA	906-822-7889	906-822-7977	erogers@up.net
Rolefson	Eric	USAF	PSC 37, Box 1942	APO	AE	09459	USA	44-1638-544718	44-1638-544721	eric.rolefson@mildenhall.af.mil
Rosche	Geoffrey	USAF, Dover AFB	201 Eagle Way, Room 204	Dover AFB	DE	19902	USA	302-677-3261	302-677-3264	geoffrey.rosche@dover.af.mil
Rossi	Cory	USDA, APHIS, Wildlife Services	1800 Glenn Hwy., Ste. 12	Palmer	AK	99645	USA	907-745-0871	907-745-0872	cory.r.rossi@aphis.usda.gov
Rowe	Greg	Sacramento County Airport System	6900 Airport Blvd.	Sacramento	CA	95837	USA	916-874-0651	916-874-0728	tenille_rubin@ourcorp.com
Rubin	Tennile	URS Corporation	4 North Park Drive, Suite 800	Hunt Valley	MD	21030	USA	410-785-7220	410-229-0628	willhelmuhe@awg.dwd.de
Ruhe	Wilhelm	German Military Geophysical Office	Biology Section, Mont Royal	Traben	Traben	D56841	Germany	49-6541-18734	49-6541-18767	russell@itc.gc.ca
Russell	Kristi	Transport Canada	330 Sparks Street, Place de Ville	Ottawa	ON	K1A 0N8	Canada	613-990-3739	613-990-0508	gsabine@birdzoff.com
Sabine	Gordon	Birdzoff	2118 Wilshire Blvd., #470	Santa Monica	CA	90403	USA	866-247-3963	818-990-9856	james.sabo@langley.af.mil
Sabo	James	USAF	103 Seminary Ridge Road	Hampton	VA	23669	USA	757-851-4884	757-764-2766	pilots@collegediplots.org.mtx
Salazar	Heriberto	Colegio de Pilotos, Aviadores de Mexico	Av. Palomas 110	Mexico	DF	11650	Mexico	5520-4652	5520-8904	laurence.m.schafer@usda.gov
Schafer	Laurence	USDA, APHIS, Wildlife Services	720 O'Leary Street NW	Olympia	WA	98502	USA	360-753-9884	360-753-9466	
Schavrien	Randy	USAF	1701 Kenley Ave., Ste. 48	Lackland AFB	TX	78236	USA	210-925-1842	210-925-2030	
Schneider	Dave	Dept. of National Defence-Canada	15 Wing Moose Jaw, P.O. Box 5000	Moose Jaw	SK	S6H 7Z8	Canada	306-694-2286	306-694-2813	
Schuetz	Robert		1400 Buse Road, Box 61	Patuxent River	MD	20670	USA	301-342-3570		
Schwaible	Robert	USAF	125 W. Hamilton Ave., Ste. 122	Colorado Springs	CO	80914	USA	719-556-4986	719-556-8160	robert.schwaible@peterson.af.mil
Seamans	Tom	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	thomas.w.seamans@aphis.usda.gov
Sengl	Jack	USDA, APHIS, Wildlife Services	2869 Via Verde Drive	Springfield	IL	62703	USA	217-241-6700	217-241-6702	jack.w.sengl@usda.gov
Servoss	Wendy	USDA, APHIS, Wildlife Services	6213-E Angus Drive	Raleigh	NC	27613	USA	919-786-4480	919-782-4159	wendy.servoss@aphis.usda.gov
Sheely	Steve	Pratt & Whitney	400 Main Street, M/S 162-24	E. Hartford	CT	06108	USA	860-557-2956	860-565-1568	sheelysk@pwh.com
Short	Jeffrey		3064 Eutaw Forest Drive	Waldorf	MD	20603	USA	202-586-2675	202-586-9440	bashman@earthlink.net
Sicard	Marc	USAF, 314 AW/SEF	1260 Thomas Avenue, Suite 107	Little Rock AFB	AR	72099	USA	501-987-8321	501-987-8140	marc.sicard@jnterrock.af.mil
Silver	Joseph	U.S. Navy, Brunswick NAS	3150 Orion Street, Bldg. 584	Brunswick	ME	04011	USA	207-921-2443	207-921-2649	silver@nasb.navy.mil
Simons	Michael	USAF	445 Suwannee Ave., Suite 144	Tyndall AFB	FL	32403	USA	850-283-4966	850-283-2515	michael.simons@tyndall.af.mil
Skagerberg	Verne	Alaska Dept. of Transportation	6860 Glacier Hwy.	Juneau	AK	99801	USA	907-465-4477	907-465-2016	verne.skagerberg@dot.state.ak.us
Slater	Michael	USDA, APHIS, Wildlife Services	3413 Del Webb Avenue	Salem	OR	97303	USA	503-399-5850	503-399-5613	michael.slater@aphis.usda.gov
Smith	Mike	USDA, APHIS, Wildlife Services	4600 Kietzke Lane, Bldg. O, Ste. 260	Reno	NV	89502	USA	775-784-5081	775-784-5874	patrick.l.smith@usda.gov
Smith	Patrick	USDA, APHIS, Wildlife Services	3419A Arden Way	Sacramento	CA	95825	USA	916-979-2675	916-979-2680	scott.snow@victoriaairport.ca
Snow	Scott	Victoria Airport Authority	201-1640 Electra Blvd.	Sidney	BC	V8L 5V4	Canada	250-953-7505	250-953-7509	scott.snow@victoriaairport.ca
Soares	Jose	USAF, Airfield Management, Unit 8025	APO AE 08720	Lajes Field	Azores	351-295-571-361	Portugal	351-295-571-361	351-295-572-229	jose.soares@lajes.af.mil
Solo	Steve	Sacramento County Airport System	7201 Earhart Drive	Sacramento	CA	95837	USA	916-874-0649	916-874-0728	sotos@isacounty.net
Spencer	Aaron	USDA, APHIS, Wildlife Services	1521 S. Lynn White Drive	Chicago	IL	60605	USA	773-852-3143	312-745-1518	aaron.d.spencer@aphis.usda.gov
Spencer	Jack	USDA, APHIS, Wildlife Services	4600 Kietzke Lane	Reno	NV	89502	USA	775-784-5081	775-784-5874	jack.o.spencer@aphis.usda.gov
Spillane	Paul	USAF	1001 N. Second Street, Suite 366	Eglin AFB	FL	32542	USA	850-882-7349	850-882-8713	paul.spillane@eglin.af.mil
Stakes	Ron	Canadian Air Force	Box 2306	Pictou	ON	K0K 2T0	Canada	613-476-7745	613-965-7539	rjstake@sympatico.ca
Stephan	James	Delta Air Lines	Bldg. A-2, P.O. Box 20706	Atlanta	GA	30320	USA	404-715-3302	404-715-2680	jim.stephan@della.com
Steuber	John	USDA, APHIS, Wildlife Services	2800 N. Lincoln Blvd.	Oklahoma City	OK	73105	USA	405-521-4039	405-525-5951	john.e.steuber@usda.gov
Stevens	Matt	USDA, APHIS, Wildlife Services	720 O'Leary Street NW	Olympia	WA	98502	USA	360-753-9884	360-753-9466	
Stewart	Billy	USDA, APHIS, Wildlife Services	9380 Bond Ave., Suite A	El Cajon	CA	92021	USA	619-561-3752	619-561-3862	
Stewart	Todd	USDA, APHIS, Wildlife Services	745 Arnold Avenue	Whiteman AFB	MO	65305	USA	660-687-3046	660-687-6106	todd.e.stewart@aphis.usda.gov
Stopak	Scott	USDA, APHIS, Wildlife Services	P.O. Box 30965	Memphis	TN	38130	USA	901-922-8792	901-922-2294	scott.r.stopak@aphis.usda.gov

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Stratton	Paul	Air National Guard, 128th ARW	4736 N. Woodruff Avenue	Whitefish Bay	WI	53211	USA	847-477-2336		pstratis@hotmail.com
Sullivan	Kevin	USDA, APHIS, Wildlife Services	1568 Whitehall Rd.	Annapolis	MD	21401	USA	410-349-8055	410-349-8258	
Summers	William	USAF, HQ Air Mobility Command	507 Symington Drive	Scott AFB	IL	62225	USA	618-229-0842	618-229-0257	will.summers@scott.af.mil
Swaby	Donnavan	USAF, BASH Team	9700 Ave G, SE, Ste. 266, Bldg. 24499	Kirtland AFB	NM	87117	USA	505-846-5673	505-846-0684	donnavan.swaby@kafb.af.mil
Swift	James	U.S. Navy, NAS Patuxent River	22541 Johnson Road, Bldg. 1410	Patuxent River	MD	20670	USA	301-757-0006	301-757-1889	
Taber	Mike	Wildlife Control Technology, Inc.	2501 N. Sunnyside Avenue	Fresno	CA	93727	USA	800-235-0262	559-490-2260	wct@wildlife-control.com
Tate	Willie	USAF Reserve Command	155 Richard Ray Blvd.	Warner Robins	GA	31098	USA	478-327-0501	478-327-0308	willie.tate@af.mil
Tate-Hall	Tamela	U.S. FWS	911 NE 11th Avenue	Portland	OR	97232	USA	503-231-6164	503-231-2019	
Teague	Dennis	USAF, Eglin Air Force Base	106 Hwy. 85 North	Niceville	FL	32578	USA	850-882-4164	850-882-5321	dennis.teague@eglin.af.mil
Ternieden	Claudio	American Association of Airport Executives	601 Madison Street, Ste. 400	Alexandria	VA	22314	USA	703-824-0500	703-820-1395	claudio.ternieden@airportnet.org
Teter	Kendra	USDA, APHIS, Wildlife Services	1568 Whitehall Rd.	Annapolis	MD	21401	USA	410-859-7367	410-859-7159	kteter@mdot.state.md.us
Tiller	David	White Water Associates, Inc.	P.O. Box 27	Amasa	MI	49903	USA	906-822-7889	906-822-7977	dtiller@up.net
Tobey	Steven	Dallas/Ft. Worth International Airport	P.O. Box 619428	DFW Airport	TX	75261	USA	972-574-8989	972-574-3411	ssobey@dfwairport.com
Tobin	Mark	USDA, APHIS, Wildlife Services	4101 LaPorte Avenue	Fort Collins	CO	80521	USA	970-266-6135		mark.e.tobin@aphis.usda.gov
Treviso	Gregorio	USAF Academy	385 Silver Spring Circle	Colorado Springs	CO	80919	USA	719-594-0137	719-333-6391	gregorio.treviso@usa.af.mil
Troxel	Seth	MIT Lincoln Laboratory	244 Wood Street	Lexington	MA	02420	USA	781-981-3658	781-981-0632	seth@ll.mit.edu
Trudell	Shaun	USDA, APHIS, Wildlife Services	P.O. Box 524	Newark	CA	94560	USA	510-918-7588		shaun.b.trudell@aphis.usda.gov
Turner	Robert	CH2M-Hill	68 Isleworth Drive	Henderson	NV	89052	USA	702-369-6904	702-369-1107	blurner1@ch2m.com
Vergote	Bruce	BirdTec, Inc.	4074 155th Avenue	Hersey	MI	49639	USA	231-832-1943	231-832-0756	birdtec@yahoo.com
Vergote	Vicki	BirdTec, Inc.	4074 155th Avenue	Hersey	MI	49639	USA	231-832-1943	231-832-0756	birdtec@yahoo.com
Vetter	Michael	USAF, 71 FTW/SE	204 Thompson, Suite 101	Vance AFB	OK	73705	USA	580-213-7627	580-213-7464	michael.vetter@vance.af.mil
Vice	Dan	USDA, APHIS, Wildlife Services	1060 Route 16, Suite 130C	Barrigada Heights	Guam	96913	USA	671-635-4400	671-635-4401	daniel.s.vice@aphis.usda.gov
Wagner	Jack	Bird Busters	300 Calvert Avenue	Alexandria	VA	22301	USA	800-662-4737		jwagner@birdbusters.com
Wagner	Theodore	USAF, 8 AF Flight Safety	245 Davis Avenue E., Room 220	Barksdale AFB	LA	71110	USA	318-456-4850	318-456-4899	theodore.wagner@barksdale.af.mil
Walho	Dave	FAA	222 West 7th Ave., #14	Anchorage	AK	99513	USA	907-271-3815	907-271-2851	david.g.walho@faa.gov
Wang	Chi-Hsin	CAA/ATSD, MOTC ROC	CAA Bldg. 340, Tun-Hwa N. Road	Taipei	Taiwan	105	ROC	8862-2349-6123	8862-2349-6122	raptor@mail.caa.gov.tw
Wang	Wen-Chou	Flight Safety Foundation	5-1, 8F, No. 51, Keelung Rd., Sec. 2	Taipei	Taiwan	110	ROC	8865-2377-5801	8865-2377-5801	fsf01@fsf.org.tw
Watson	Brian	USAF, Hill AFB	5970 Southgate Ave., Bldg. 1	Hill AFB	UT	84056	USA	801-777-3592	801-775-2452	brian.watson@hill.af.mil
Watson	James	USDA, APHIS, Wildlife Services	Box 2225	Locust Grove	OK	74352	USA	918-598-3020	405-525-5951	
Weissinger	Mark	USDA, APHIS, Wildlife Services	2224 W. Desert Cove, Suite 209	Phoenix	AZ	85029	USA	602-870-2081	602-870-2951	aspleenic@aol.com
Weitz	Heinrich	German Military Geophysical Office	Biology Section, Mont Royal	Trarbach	Germany	D56841		49-6541-18735	49-6541-18767	heinrichweitz@awg.dwd.de
Wenning	Krista	USDA, APHIS, Wildlife Services	2224 W. Desert Cove	Phoenix	AZ	85029	USA	602-870-2081	602-870-2951	krista.m.wenning@aphis.usda.gov
Whisson	Desley	University of California	One Shields Ave.	Davis	CA	95616	USA	530-754-8644	530-752-4154	dawhisson@ucdavis.edu
White	James	FAA	800 Independence Ave., SW	Washington	DC	20591	USA	202-267-7605	202-267-8821	
White	Randolph	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	randolph.j.white@aphis.usda.gov
Whitford	Philip	Capital University	2199 E. Main Street	Columbus	OH	43209	USA	614-236-6591	614-236-6518	pwhitford@capital.edu
Whitford	Shane	USAF, Airfield Survey	PACAF/TALCE, Box 78	Yokota	Japan		USA			shane.whitford@yokota.af.mil
Williams	Karen	City of Phoenix	200 West Washington Street, 12th Floor	Phoenix	AZ	85003	USA	602-262-4717	602-261-8329	karen.williams@phoenix.gov
Williams	Terri	USAF	405 S. Doolittle Avenue	Fairchild AFB	WA	99011	USA	509-247-2424	509-247-3722	leonard.burns@fairchild.af.mil
Wilmoth	Bill	USDA, APHIS, Wildlife Services	1800 Glenn Hwy., Suite 12	Palmer	AK	99645	USA	907-745-0871	907-745-0872	bill.f.wilmoth@aphis.usda.gov
Wiltz	Darroll	USAF	PSC Box 6669	APO	AP	96326	USA	81-3117-55-3161	81-3117-55-7096	darroll.wiltz@yokota.af.mil

ATTENDEES AT BSC-USA/CANADA 2002

LNAME	FNAME	ORGANIZATION	ADDRESS	CITY	ST	ZIP	COUNTRY	PHONE	FAX	EMAIL
Windler	Peter	USAF, BASH Team	9700 Ave G, SE, Suite 266, Bldg. 24499	Kirtland AFB	NM	87117	USA	505-846-5674	505-846-0684	pete.windler@kafb.af.mil
Winfield	Greg	Winfield Solutions	Box 578	Frankford	ON	K0K 2C0	Canada	613-398-1221	613-398-8649	winsol@reach.net
Winfield	Sue	Winfield Solutions	Box 578	Frankford	ON	K0K 2C0	Canada	613-398-1221	613-398-8649	winsol@reach.net
Winterboer	Diane	USDA, APHIS, Wildlife Services	2224 W. Desert Cove	Phoenix	AZ	85029	USA	602-870-2081	602-870-2951	
Witmer	Gary	USDA, APHIS, Wildlife Services	4101 LaPorte Avenue	Fort Collins	CO	80521	USA	970-266-6095	970-266-6095	gary.w.witmer@usda.gov
Wisoe	Mark	Mineta San Jose International Airport	1732 N. First Street, Suite 600	San Jose	CA	95112	USA	408-277-4394	408-277-3191	mwitsoe@sjic.org
Wolfe	Jody	USAF, Airfield Management	5970 Southgate Avenue	Hill AFB	UT	84056	USA	801-775-6752	801-777-7426	jody.wolfe@hill.af.mil
Wood	Jason	USDA, APHIS, Wildlife Services	3218 Main Street	Chimcoleague	VA	23336	USA	757-824-1254	757-824-1250	jwood50@hotmail.com
Wright	Sandra	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	sandra.e.wright@aphis.usda.gov
Wright	Tommy	U.S. Navy	36949 Tanyard Drive	Mechanicsville	MD	20659	USA	202-685-3447	202-685-3350	
Yo	Shacpin	Chung-Hsing University	2634 Albany Avenue	Davis	CA	95616	USA	530-758-3619	530-758-6538	siscusa@aol.com
Zakrajsek	Edward	Geo-Marine, Inc.	3160 Airport Road, Suite 22A	Panama City	FL	32405	USA	850-913-8003	850-913-9582	radarzak@aol.com
Zemsky	Mona	Bird-X, Inc.	300 N. Elizabeth Street	Chicago	IL	60607	USA	312-226-2473	312-226-2480	mona@bird-x.com



SACRAMENTO COUNTY AIRPORT SYSTEM

4th JOINT MEETING



BIRD STRIKE COMMITTEE USA/CANADA



**Hyatt Regency
Sacramento, California
October 21-24, 2002**

WELCOME

Bird Strike Committee-USA and Bird Strike Committee Canada welcome you to the 2002 Bird Strike Meeting in Sacramento. We have a full agenda of technical sessions, military/civil airports briefings, a field trip, demonstrations, exhibitor displays, posters, and social events that should provide ample opportunity for information exchange, networking, professional growth, and fun! Please take advantage of the various opportunities so that you can return home with fresh ideas, expanded contacts, new friends, pleasant memories, and a renewed commitment to actions that will produce safer skies for all who fly, birds and people.

Richard A. Dolbeer, Chair, BSC-USA and Bruce MacKinnon, Chair, BSCC

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REGISTRATION DESK

Located in the foyer by the Regency Ballroom

<u>Date</u>	<u>Time</u>
Sunday, October 20, 2002	1700-2100
Monday, October 21, 2002	0800-2000
Tuesday, October 22, 2002	0700-1800
Wednesday, October 23, 2002	0700-1200
Thursday, October 24, 2002	0700-1600

REFRESHMENT AND MEAL SERVICE

(Box lunch and coffee breaks included in registration fee)

Coffee Breaks will be located in the Exhibitor Hall in the Regency Corridor

DATE	TIME	EVENT	LOCATION
Monday, 21 Oct	1800-2000	Welcome Reception	Regency Ballroom
Tuesday, 22 Oct	1200-1320	Box lunch	Regency Foyer North
Wednesday, 23 Oct	1200-1300	Box lunch	Regency Foyer North
Wednesday, 23 Oct	1800-2000	Meet-the-Exhibitors Social	Regency Corridor

GENERAL INFORMATION

Name Badges

Please wear your name badge at all times.

Evaluation Sheets

Kindly fill out the evaluation sheet that is included in the registration packet to receive a commemorative model airplane for the Bird Strike 2002 meeting.

Technical Sessions

All technical sessions take place in the Regency DEF Ballroom
Exhibitors are located in the Regency Corridor

USA/Canada Water Volleyball Tournament

Wednesday, 23 October 2002 at 2000

Optional Tours

Guided Bird and History Walk: Wednesday, 23 October 2002, 0630-0800 in Capital Park across from Hotel. Meet in lobby at 0630.

Conference Sponsors

Bird Strike Committee USA thanks the U.S. Department of Agriculture, Wildlife Services and U.S. Air Force, Office of Scientific Research for their generous support of the conference.

EXHIBITORS (located in the Regency Corridor)

The following exhibitors welcome you to visit:

Arkion Life Sciences/FlightControl 3521 Silverside Road Wilmington, DE 19810 USA 302-695-5781 302-695-5763 fax <i>ballinger@flightcontrol.com</i>	FlightControl Plus Geese Repellent, first developed for bird strike hazards, has proven effective in conditioning geese to relocate off "no tolerance" zones such as flight operation areas, athletic fields, hospitals, etc.
BASH Inc. 5010 Lanagan Street Colorado Springs, CO 80919 USA 719-264-8420 719-264-8420 fax <i>bashincdonna@aol.com</i>	BASH Inc. is a small company specializing in Bird Aircraft Strike Hazard (BASH) and Wildlife Management. We provide consultant services in development of BASH plans for civil and military aviation, land-use planning, wildlife mitigation plans, bird avoidance modeling, aircraft accident investigations, NEPA documentation, education, and training.
Becker Underwood 801 Dayton Avenue Ames, IA 50010 USA 515-232-5907 515-232-5961 fax <i>www.beckerunderwood.com</i>	Becker Underwood is the manufacturer of the ReJeX-iT brand product line, which is a nonlethal method of bird control. ReJeX-iT products are available in 3 formulations, sold under the brand names Fog Force, Migrate, and Crop Guardian. The active ingredient is non-toxic and can repel many species of birds.
Bird-X, Inc. 300 N. Elizabeth Street Chicago, IL 60607 USA 312-226-2473 312-226-2480 fax <i>mona@bird-x.com</i>	New this year: GooseBuster. Actual alarm calls of Canada geese recorded under natural conditions; geese recognize them and respond. Twenty-three years of research on their behavior and communication by noted biologist, Dr. Philip Whitford.
Clickairport Faraday House, 38 Poole Westbourne Bournemouth B4154A UK 44-1202-76531 44-1202-66536 fax <i>dan.leigh@clickairport.com</i>	Innovative wireless software applications for bird/wildlife management at airports through the use of cutting-edge technology. Rapid and accurate information received in seconds.
Electrobraid Fence Limited 1021 Beaufort Avenue Halifax, NS B3H3Y1 Canada 902-422-6678 902-422-0094 fax <i>dbryson@electrobraid.com</i>	To keep deer off airfield runways. Low cost, low maintenance. Evaluated by the USDA. Approved by the USAF, U.S. Navy, FAA, and Transport Canada.

Geo-Marine, Inc. 3160 Airport Road, Suite 22A Panama City, FL 32405 USA 850-913-8003 850-913-9582 fax <i>bashbam@aol.com</i>	The Avian Research Laboratory (ARL) is dedicated to providing innovative solutions for reducing bird and wildlife hazards to aviation. ARL leads the world in automated radar tracking of birds for aviation applications. This highly trained and experienced research group also provides wildlife hazard assessments, comprehensive management plans and training programs for commercial airports and military operations.
Goosedog.com 221 E. Cherry Lane Coalinga, CA 93210 USA 559-935-8309 <i>canadaybc@onemain.com</i>	A high quality goose control dog is the most humane and effective way of dealing with nuisance bird management issues. We have 28 years of combined experience in training.
Margo Supplies Ltd. P.O. Box 5400 High River, AB T1V1M5 Canada 403-652-1932 403-652-3511 fax <i>jmarley@margosupplies.com</i>	Margo Supplies provides solutions for wildlife problems. Our radio-controlled cannons and pyro launchers with rapid and simultaneous firing capabilities, deliver aggressive hazing to enhance your BASH program.
Phoenix Agritech P.O. Box 10 Truro, NS B2N5B6 Canada 902-662-2444 902-662-2888 fax <i>phoenix@fox.nstn.ca</i>	Phoenix Agritech is based in Nova Scotia, where it manufactures the Phoenix Wailer Bird Deterrent System. Incorporated in February 1992, we continue to develop new and improved electronic bird deterrents using the latest technology.
Precise Flight 63120 Powell Butte Road Bend, OR 97701 USA 541-382-8684 541-388-1105 fax <i>stevec@preciseflight.com</i>	Precise Flight, Inc. manufactures and certifies the Pulselite System, which flashes aircraft external lights. Flashing lights have been shown to provide closing rate and direction information. They also have been shown to improve avian escape-reaction time.
Reed-Joseph International Company P.O. Box 894 Greenville, MS 38702 USA 800-647-5554 662-335-8850 fax <i>jbj3@reedjoseph.com</i>	Celebrating our 50 th anniversary, Reed-Joseph is the nation's oldest and largest distributor of bird and wildlife control products. Our wide variety of Scare-Away TM LP gas cannons and pyrotechnic devices are vital components of BASH programs across the country. Stop by our booth to see how we can help your program!

Scarecrow Bio-Acoustic Systems P.O. Box 66 Uckfield, East Sussex TN223ZR UK 44-1825-732601 44-1825-732730 fax <i>sales@scarecrowbio-acoustic.co.uk</i>	Scarecrow Systems are perhaps the largest specialists and the acknowledged leader in bio-acoustic bird control technology, the reason why their products are 'preferred' by airport and aerodrome operators and at other strategic sites where birds present a hazard to safety.
Sutton Ag Enterprises, Inc. 746 Vertin Avenue Salinas, CA 93901 USA 831-422-9693 800-482-4240 fax <i>dianesuttonag@earthlink.net</i>	Specialists in commercial bird control for 45+ years. The U.S. distributor for BIRD BOMBS®, WHISTLERS®, ZON CANNONS® also offers a complete line of sonic, visual and exclusionary controls.
Wildlife Control Center 515 Concord Ind. Drive Seneca, SC 29672 USA 864-882-1647 864-862-5239 fax <i>wildlifecontrol@hotmail.com</i>	The Wildlife Control Center specializes in superior pyrotechnic wildlife control products for airports, the agriculture industry and many other areas.
Wildlife Control Technology, Inc. 2501 N. Sunnyside Avenue Fresno, CA 93727 USA 800-235-0262 559-490-2260 fax <i>miket@wildlife-control.com</i>	Wildlife Control Technology, established in 1978, can provide the full spectrum of products and service for wildlife management in the airport industry.
Winfield Solutions Box 578 Frankford, ON K0K2C0 Canada 613-398-1221 613-398-8649 fax <i>winsol@reach.net</i>	As North America's leading provider of wildlife/hazard management software to airports, we are enabling staff to make cost-effective, pro-active decisions.

Bird Strike Committee USA Policy on Endorsements of Companies, Products, and Techniques

BSC-USA meetings are open to all people interested in aviation safety and in scientific-based products, techniques, and strategies to minimize wildlife hazards to aircraft. The primary goal of BSC-USA is to provide a forum (technical presentations, demonstrations, and exhibitor displays) to facilitate communication among the diverse disciplines working to minimize the conflicts between wildlife and aviation. BSC-USA thanks the various companies and individuals that share information regarding products and techniques. However, BSC-USA and the agencies represented on the BSC-USA Steering Committee do not endorse specific companies, products, and techniques that are displayed, demonstrated or discussed at BSC-USA meetings. Wildlife management is a complex endeavor, especially on airports, and products or techniques that work under one set of circumstances may not be appropriate in other situations. Attendees are encouraged to ask critical questions and to carefully evaluate information, equipment, and products presented at meetings.

Bird Strike Committee USA Steering Committee

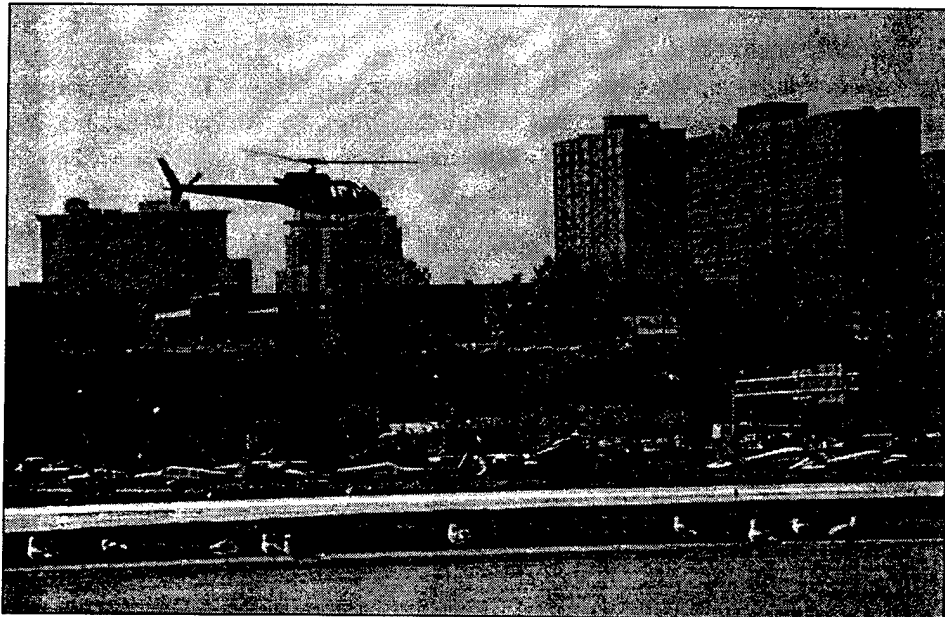
Bird Strike Committee-USA is directed by a 9-person steering committee consisting of 2 members each from the Federal Aviation Administration, U.S. Departments of Agriculture and Defense, and 3 from the aviation industry (AI). Members serve 2-year terms. Current members are:

Richard Dolbeer, USDA (Chair)
Kirk Gustad, USDA

Ed Cleary, FAA (Vice-Chair)
John Lott, FAA

Gene LeBoeuf, DoD
Peter Windler, DoD

Russ DeFusco, AI (Sec/Treas)
Paul Eschenfelder, AI
John Ostrom, AI



KEYNOTE SPEAKER

The Bird Strike Committees of USA and Canada are honored to have Dr. Walter E. "Howdy" Howard make the Keynote Address at our 2002 meeting:

Dr. Howard, who conducted his first wildlife damage control study in 1939, received his AB in Zoology from the University of California at Berkeley and his MS and PhD in Animal Ecology from the University of Michigan. He spent 3 years in World War II, starting in the ski troops in the Aleutian Islands and finishing in the USA Typhus Commission (with staff from Communicable Disease Center) on Stillwell Road in northern Burma.

He has been a teacher and researcher at University of California, Davis since 1947. Dr. Howard credits his 46 MS and PhD students and the many thousands of classroom students as also being his teacher. He became Emeritus in Wildlife Biology and Vertebrate Ecology in 1987 when he turned 70, but Emeritus is by title only for he goes to his office daily and is currently seeking a Publisher for a new book (memoirs) titled "Saved by Bedbugs".

Dr. Howard's research-lecture program has been to learn how people can best cohabitate with animals. One goal is to help people understand nature and society's moral and ethical right to use animals responsibly. His research fields include animal welfare, wildlife damage control, and how to improve the health of the environment. He has lectured extensively on these subjects and been on over 30 radio and TV programs. He has lectured or consulted in other countries 54 times since his first Fulbright Research Scholarship in New Zealand in 1957-58. He has about 500 publications and circulated reports on animal welfare and the behavior and management of wild vertebrate animals.



Dr. Walter E. "Howdy" Howard

PROGRAM

MONDAY, 21 OCTOBER 2002

- 0800 **REGISTRATION** (Regency Foyer)
- 1000 **BSC-USA STEERING COMMITTEE MEETING** (Sequoia Board Room)
- 1300-1700 **EARLY-BIRD PYROTECHNICS TRAINING** (Regency A and Mather Field)
- 1800-2000 **WELCOME RECEPTION** (Regency AB) hosted by *Sacramento County Airport System*

TUESDAY, 22 OCTOBER 2002

- 0700 **REGISTRATION** (Regency Foyer)

PLENARY SESSION

- 0800 **Welcome to Sacramento** – *G. Hardy Acree, Director of Airports, Sacramento County Airport System*
- 0810 **Welcome to BSC-USA/Canada** - *Richard Dolbeer, U.S. Department of Agriculture (USDA), Wildlife Services (WS), and Chairperson, BSC-USA; and Bruce MacKinnon, Transport Canada, and Chairperson BSC Canada*
- 0815 **Keynote Address: Managing Nature in Today's World** by *Dr. Walter "Howdy" Howard, Professor Emeritus, University of California at Davis (1)*
- 0845 **Plenary Address: Mandatory Strike Reporting: The Time has Come** by *Captain Paul Eschenfelder, Air Line Pilots Association (2)*
- 0910 **Compliance with Wildlife Hazard Regulations: An Air Carrier's Perspective** by *Vern Berry, Evergreen Intl. Airlines & Air Transport Association Safety Council (3)*
- 0930-1000 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION I: WILDLIFE RISK ASSESSMENT
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- 1000 **Development of Birdstrike Risk Assessment Procedures, Their Use on Airports, and Potential Benefits to the Aviation Industry** by *John Allan, Central Science Laboratory; A. Orosz, United Airlines; A. Badham, BAA,; J. Bell, Central Science Laboratory (4)*
- 1020 **Improving the United States Bird Avoidance Model (USBAM) Predictive Risk Surface** by *Mark Alexander, M. Bobo, Geo InSight Intl, Inc; R. DeFusco, BASH Inc. (5)*
- 1040 **Implementation of GIS Technology to Detect Wildlife Hazards at Airports** by *Shelley Gray, USDA, Wildlife Services (6)*
- 1100 **Reported Bird Strikes at Down-State Illinois Airports** by *Michael Rapps, Rapps Engineering & Applied Science (7)*

- 1120 **Influence of the BASH Phase II Program on Reduction of Bird Strikes to Air Mobility Command Aircraft** by *Brian Oswalt, USAF (8)*
- 1140 **Development and Maintenance of Airport Wildlife Hazard Mitigation Website for the FAA and its Use as a Communication Tool** by *Archie Dickey, Allen Newman, ERAU (9)*
- 1200-1320 **BOX LUNCH PROVIDED (Foyer)**

TECHNICAL SESSION II: RADAR DEVELOPMENT
--

- 1320 **Progress Report on Development of a Terminal Area Bird Detection and Monitoring System Using the ASR-9** by *Seth Troxel, B. Echels, W. Pughe, M. Weber, MIT Lincoln Laboratory (10)*
- 1340 **A Progression of Avian Radar Studies at Airfields** by *Ed Zakrajsek, C. Matkovich, A. Smith, Geo-Marine, Inc. (11)*
- 1400 **Advances in Radar Technology for Bird Strike Risk Assessment** by *T. Adam Kelly, R. Merritt, R. White, M. Howera, T. West, Geo-Marine, Inc. (12)*
- 1420 **Bird Detection and Radar Wind Profilers** by *Scott McLaughlin, Applied Technologies, Inc. (13)*
- 1440 **Development of a Portable Bird Detection Radar for Airports** by *Michel Hovan, FAA Airport Technology R&D Branch (14)*
- 1500-1530 **BREAK (Visit the Exhibitors)**

TECHNICAL SESSION III: MANAGEMENT TECHNIQUES

- 1530 **Need for Certification Program for Persons Conducting Wildlife Hazard Management Activities at Airports** by *John Ostrom, MSP International Airport (15)*
- 1550 **Even with Good Equipment, Experienced Manpower is Necessary** by *Nigel Horton, NH Bird Management (16)*
- 1610 **Increasing Air Safety at Eglin Air Force Base through Vulture Roost Dispersal** by *John Humphrey, USDA, NWRC (17)*
- 1630 **A New Technology to Repel Birds: The High-Intensity Acoustic Bird Dispersion System (HIABDS)** by *Xi Baoshu, Zhou Mingjun, Wang Jingqun, Tsinghua University; R. Dolbeer, USDA, WS; T. Seamans, USDA, NWRC (18)*
- 1650 **Emergency Wildlife Management Response to Protect Evidence Associated with the Terrorist Attack on the World Trade Center, New York City** by *Rich Chipman, K. Preusser, J. Gansowski, C. Cranker III, D. Sullivan, R. Dolbeer, USDA, WS; T. Seamans, USDA, NWRC; L. Francoeur, PANYNJ (19)*
- 1710 **FIELD TRIP BRIEFING**

WEDNESDAY, 23 OCTOBER 2002

0630-0800 **GUIDED BIRD and HISTORY WALK** (Capital Park, meet in lobby at 0630) *led by Carl Burke, Sacramento International Airport*

0730-0845 **MILITARY/CIVIL BREAKOUT SESSION** (Regency DEF)

TECHNICAL SESSION IV: INTERNATIONAL BIRD STRIKE ISSUES

0900 **Strides in Bird Hazard Control at Entebbe International Airport** *by Gloria Bitebekezi, Civil Aviation Authority, Uganda (20)*

0920 **Bird Hazard Control Program at Panama Airports** *by Esteban Godinez, Mision de Cooperacion Tecnica de al OACI en Panama (21)*

0940 **Evaluation and Mitigation of Bird Hazards in Ex-Vaso de Texcoco: The Proposed Site of a New International Airport for Mexico City** *by Ed Cleary, FAA; R. Dolbeer, USDA, WS; P. Bastida, Universidad Nacional Autonoma de Mexico (22)*

1000-1020 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION IV (continued): INTERNATIONAL BIRD STRIKE ISSUES

1020 **The Evolution of Transport Canada's Wildlife Management and Planning Program** *by Bruce MacKinnon, Kristi Russell, Transport Canada (23)*

1040 **Wildlife Hazard Management in Micronesia: Aviation Safety in Uncharted Territory** *by Dan Vice, USDA, WS (24)*

1100 **Avian Hazard Control in Brazil: Essential Role of the Aeronautical Accidents Prevention and Investigation Center-CENIPA** *by Luiz Claudio Magalhaes Bastos, Brazilian Aeronautical Accident Prevention and Investigation Center (25)*

1120 **The Brazilian Civil Aviation Department (DAC) and Bird Strike Control in Brazil** *by Jandrisson Gurgel do Amaral, Brazilian Air Force (26)*

1140 **Bird Strikes in Courts: The Genoa Case** *by Valter Battistoni, BSC Italy (27)*

1200-1300 **BOX LUNCH PROVIDED** (Foyer)

1300-1700 **FIELD TRIP TO SACRAMENTO INTERNATIONAL AIRPORT**

Land-Use Planning to Avoid Bird Hazards around Sacramento International Airport *by John Febbo, Senior Airport Planner, Sacramento International Airport*

1800-2000 **"MEET THE EXHIBITORS" SOCIAL** (Regency Corridor)

2000 **USA vs. CANADA WATER VOLLEYBALL GAME**

THURSDAY, 24 OCTOBER 2002

TECHNICAL SESSION V: LARGE-BIRD ISSUES

- 0900 **Canada Goose Population Management at the Minneapolis-St. Paul International and Downtown St. Paul Airports** by *Jim Cooper, University of Minnesota (28)*
- 0920 **Monte-Carlo Simulation of Birdstrike to Support Rule Making for Large Birds** by *Julian Reed, Rolls-Royce (29)*
- 0940 **Aircraft Engines and Large Flocking Birds** by *Dick Parker, Pratt & Whitney (30)*
- 1000-1020 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION VI: HABITAT & BIRD BEHAVIOR ISSUES

- 1020 **Potential of Grass-Endophytes as a Bird Deterrent: Concept Testing with Canada Geese** by *Chris Pennell, P. Rolston, AgResearch Limited (31)*
- 1040 **Aspects of the Feeding Ecology of Avifauna at an Inland Airport, South Africa** by *Ordino and Lettie Kok, Department of Zoology and Entomology (32)*
- 1100 **Assessing Bird Strike Hazards in Coastal Wetlands through Field Experiments** by *John Ledbetter, City of Santa Barbara; J. Gray, URS Corporation (33)*
- 1120 **Effects of Location and Phase of Flight on the Behavioral Responses of Birds to Aircraft: Preliminary Observations** by *Tom Kelly, M. O'Callaghan, P. Bourke, National University of Ireland, Cork; L. Buurma, Royal Netherlands Airforce; R. Bolger, Aer Rianta (34)*
- 1140 **Efficacy of Aircraft Landing Lights in Stimulating Avoidance Behavior in Birds** by *Brad Blackwell, G. Bernhardt, USDA, NWRC (35)*
- 1200-1320 **LUNCH ON YOUR OWN**

TECHNICAL SESSION VII: HABITAT & MANAGEMENT TECHNIQUES

- 1320 **A Paradigm Shift in Bird Strike Prevention by the Israeli Air Force** by *Nick Carter, Border Collie Rescue, Inc. (36)*
- 1340 **Management of Rodent Populations at Airports** by *Gary Witmer, USDA, NWRC; J. Dewey, USDA, WS (37)*
- 1400 **Efficacy of Translocation of Red-tailed Hawks from Airports** by *Laurence Schafer, USDA, WS; J. Cummings, USDA, NWRC; J. Yunger, Governors State University; K. Gustad, USDA, WS (38)*
- 1420 **Translocating Common Nighthawks at McConnell AFB, Kansas, to Reduce Aircraft Strikes** by *John Cummings, P. Pochop, J. Davis, D. York, USDA, NWRC (39)*
- 1440 **A Small Pond Off-Airfield Provides More than Water** by *Nigel Horton, NH Bird Management (40)*

1500-1530 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION VIII: MANAGEMENT TECHNIQUES & WRAP UP
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- 1530 **Automated Haze Systems with Methyl Anthranilate Eliminate Nuisance Birds in Aviation Hangars, Warehouses, Airports** by *Bruce Vergote, BirdTec (41)*
- 1550 **Responses of Captive Birds to Candidate Perching Deterrents on FAA LLWAS Units** by *Mike Avery, A. Genchi, USDA, NWRC (42)*
- 1610 **Evaluation of Electrobraided Fencing as a Deer Barrier** by *Tom Seamans, Z. Patton, K. VerCauteren, USDA, NWRC (43)*
- 1630-1700 **Wrap-Up and Closing Remarks** - *Bruce MacKinnon and Richard Dolbeer*
- 1700 **BSC-USA/CANADA Steering Committee Meeting** (All Welcome)
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POSTERS (Hyatt Regency Sacramento – Regency DEF)

“Birdstrike” – What’s The Word? by *Carla Dove, Smithsonian Institution (P1)*

Birdstrike Identification by *Carla Dove, Smithsonian Institution (P2)*

Attracting Arctic Foxes to Relocate a Gull Colony at Keflavik International Airport by *Pall Hersteinsson, University of Iceland; Gudmundur Örn Jonsson, Naval Air Station Keflavik (P3)*

Identification of Batstrikes by *Suzanne Peurach, USGS, PWRC and Smithsonian Institution (P4)*

Conducting an Economical Wildlife Hazard Assessment Using a Wildlife Incursion Log by *Elizabeth Rogers and David Tiller, White Water Associates, Inc. (P5)*

Status of North American Canada Goose Populations by *John Seubert, USDA, NWRC-Retired (P6)*

Environmental Analysis of Wildlife Hazard Management Programs: Application of NEPA and Possible Consequences for Implementing New Plans by *Ken Wallace, SWCA (P7)*

Successful Use of Alarm/Alert Call Playback to End Canada Goose Problems at an Ohio Business Park by *Philip Whitford, Capital University (P8)*

Animal Ambush at the Airport: The Extent and Nature of Non-bird Wildlife Strikes with Civil Aircraft, USA, 1990-2001 by *Sandra Wright, USDA, NWRC and Richard Dolbeer, USDA, WS (P9)*

ABSTRACTS

(1) Managing Nature in Today's World

Walter E. (Howdy) Howard, Professor Emeritus of Wildlife Biology and Vertebrate Ecology, Department of Wildlife, Fish and Conservation Biology, University of California, Davis, CA 95616 USA

The objective of my talk is to help airport authorities better understand the turmoil they encounter when managing birds and other wildlife populations. Many are reluctant to manage birds and mammals because they know that it will inevitably stir up controversy. Especially this is true when the program includes lethal means. Many people think all problems can be resolved by using non-lethal frightening devices or by live-trapping offending animals and relocating them away from airports. There are some sound arguments as to why it is biologically, ecologically and ethically proper to even use lethal means to resolve some airport wildlife problems. The public needs to recognize that we are dealing with people-modified environments rather than natural scenes, and that the solution to airport bird strikes, for example, cannot be left to the whims of nature. People need to understand that all animals die. Nature requires that most die before they become sexually mature and such deaths usually leaves space for another of that species. Further, when animals are killed by a wildlife manager, they nearly always die far more humanely than when they die naturally. People are the most humane of all predators. Nature, though beautiful, is a tough fang and claw arena where the survival of the fittest regime is composed of a cruel and brutal death ethic. Living in the wild is not free of suffering. The main functions of organisms are to survive, reproduce and serve as food to others. Everything in nature is linked together by eating and being eaten. The balance of nature would collapse without meat eaters and predators. Our ethic about animals is against inflicting unnecessary pain and distress to animals, but not against killing when science-based wildlife management requires it.

(2) Mandatory Strike Reporting: The Time has Come

Paul Eschenfelder, Air Line Pilots Association, 16326 Cranwood, Spring, TX 77379 USA

The reporting of wildlife collisions with aircraft in almost all places, worldwide, is voluntary. As a result data with which to design, manufacture and operate aircraft to mitigate this hazard is poor. Voluntary reporting of strikes has resulted in data collection rates in the USA of around 20%, and only about 9% of the reported strikes contain complete data on bird species. Aviation manufacturers also agree that collection of strike data is difficult, incomplete and without an industry best practice. Air carriers, when research is done, are amazed to find that strike rates may be eight times higher than their normal collection methods demonstrate. The USA safety agency, NTSB, has recommended that wildlife strike reporting be mandatory. Reporting methods and databases, in the USA and Canada, are already in place. ICAO maintains a strike database for states worldwide, but participation is poor. While the cost of mandatory reporting is often cited as a reason for not implementing mandatory reporting, the cost of not reporting is higher. Since 1995, over 130 people, worldwide, have lost their lives to collisions between wildlife and aircraft. Air carriers lose US\$1.2 billion to bird strikes each year. If carriers reduced this loss by only 25%, the savings to carriers each year would be US\$300 million. Without adequate data, neither the location, nor the frequency, nor the type of problem wildlife can be adequately identified. Neither adequate aircraft design nor operating techniques can be developed without data. Voluntary reporting has not worked: it is time for mandatory reporting of data.

(3) Compliance with Wildlife Hazard Regulations: An Air Carrier's Perspective

Vern Berry, Evergreen International Airlines and Air Transport Association (ATA) Safety Council, 3850 Three Mile Lane, McMinnville, OR 97128 USA

As a safety professional at Evergreen International Airlines, I have first-hand experience of the damage caused by wildlife. Seven major bird strikes have cost Evergreen approximately \$20 million in damages and lost revenue over a 5-year period. These events often occurred during critical phases of flight. For example, one Evergreen B-747 suffered severe damage to engine and pylon structure with subsequent loss of control during climb. You cannot train for every possible aircraft failure induced by bird strikes. The time will come, with or without the collection of additional bird-strike statistics, when damage from a bird strike will exceed the crew's ability to recover an airplane at the limits of its performance envelope.

Most carriers sitting at the ATA Safety Council can attest to similar experiences resulting in the same flight crew excitement. However, we are not tasked with regulatory responsibility for controlling wildlife hazards on air fields. This activity belongs to the nation's airports. Our concern over the number of resident birds located on or near airports has increased to the point that we are moved to make known our concerns in a public way. We do not wish to be blindsided by a major accident when the means to reduce the risk of such accidents are available.

While the full extent of the risk is not always clear, it is clear that a bird-strike risk exists. Our costs from strike events point to it. The statistics and literature attest to increasing populations of resident and migratory birds and the increase in air traffic. Aircraft damage costs increase. Clearly, the opportunity of direct interaction between aircraft and birds has increased. It would seem that we have sufficient data to expect action. The military spends a significant amount of money in prevention efforts. Their actions to date have reduced the risks to flight crews and reduced loss of aircraft to wildlife hazards. The commercial aviation world should do no less.

Yet, I hear that we need more reporting or that the full extent of the risks is not known. Action is costly and should wait until the data point to a real problem. The ATA Safety Council finds this line of reasoning flawed. FAA Guidelines and FAR's are in place. Effective compliance with these rules and guidelines can reduce further the risks that we currently perceive. These are low hanging fruit.

Some airports are in excellent compliance---some are not. In Safety, our efforts are focused on the reduction of risk. The expectation of compliance to federal standards and guidelines is reasonable. The means to do so are available and should be enforced consistently nationwide. While new and effective means of reducing wildlife presence are developed, much can be done now if regulations are effectively enforced at all U.S. domestic airports.

(4) Development of Birdstrike Risk Assessment Procedures, Their Use on Airports, and the Potential Benefits to the Aviation Industry

J. R. Allan, Central Science Laboratory, Birdstrike Avoidance Team, Sand Hutton, York, YO41 1LZ UK

A. Orosz, United Airlines, FOD Project Manager, SFOEP - Building 84, San Francisco International Airport, San Francisco, CA 94128-3800 USA

A. Badham, BAA, Group Airport Operations Manager, 8th Floor South Roof Office Block, Gatwick Airport, West Sussex, RH6 0NP UK

J. Bell, Central Science Laboratory, Birdstrike Avoidance Team, Sand Hutton, York, YO41 1LZ UK

Over the past 2 years, CSL has been involved in the development of formal risk assessment procedures for the birdstrike hazard to aircraft. These risk assessments have now been carried out at all BAA airports in the UK, and the impact of this process on the bird management at the different airports can begin to be assessed. The risk assessment process itself has also been refined over the same period, and calculations made to determine

how the various target levels for birdstrike frequency, particularly those which, if not met, require further bird management to be undertaken, relate to absolute levels of risk (e.g., risk of financial loss or of a catastrophic accident). In parallel to this, calculations have been undertaken to determine the costs of birdstrikes to world aviation. This has involved obtaining data from particular airlines and extrapolating to the world fleet. As the airlines gather more data, the cost estimates have been refined. The impact of improvements generated by the risk assessment process can now be expressed in terms of costs saved to the industry. This paper presents the latest developments in this process, demonstrates the benefits of proper risk assessment in birdstrike prevention, and advocates the adoption of formal risk assessment in airport bird control world wide.

(5) Improving the United States Bird Avoidance Model (USBAM) Predictive Risk Surface

Mark Alexander, Geo InSight International, Inc., 7710 North Union Blvd. Suite 105, Colorado Springs, CO 80920 USA

Matt Bobo, Geo InSight International, Inc., 1015 Mark Avenue, Carpinteria, CA 93013 USA

Dr. Russell P. DeFusco, Lt Col USAF (Ret.), Vice President, BASH Inc., 5010 Lanagan Street, Colorado Springs, CO 80919 USA

The United States Bird Avoidance Model (USBAM) uses Geographic Information System (GIS) technology to analyze and correlate bird habitat, migration, and breeding characteristics, combined with key environmental and man-made geospatial features. The Application consists of raster grids covering the conterminous USA. The value for each grid pixel location is equivalent to the sum of the mean bird mass (in ounces), for all species present during a particular daily time period, for one of 26 2-week periods in a year. The original USBAM is a desktop application that has an intuitive design and includes separate interfaces for multiple user profiles such as Air Crews, and Planners/Schedulers. It is based on ESRI's ArcView GIS and can be used with other network, office, and technical applications. Geo InSight has recreated this functionality and interface in a web-based environment. The original data sets used to create the BAM (Christmas Bird Count [CBC] and Breeding Bird Survey [BBS] data from 1966-1992) have been updated to include more recent data (CBC to 1997 and BBS to 2000). An analysis of the species population records that were used for the original BAM surface with newly acquired data has been conducted. The results of these analyses and individual tests performed on a selection of priority species have resulted in an enhanced statistical methodology. These newly developed techniques have been employed on the updated datasets to improve the accuracy of the risk surface. Currently, research is being conducted to create a model to enhance the risk surfaces by linking species distributions and refined migration rules to selected co-registered environmental and topographic data layers. Based on the existing, working model, the refined migration rules for each species will be translated through a programmed logic structure. The objective of this enhanced model is to develop an improved predictive risk surface that will account for the dynamic nature of species distributions and migration patterns to and from source and destination areas.

(6) Implementation of GIS Technology to Detect Wildlife Hazards at Airports

Michelle L. Gray, USDA, Wildlife Services, 6213-E Angus Drive, Raleigh, NC 27617 USA

The use of Geographic Information Systems (GIS) for displaying spatial data is a well established technique widely used by many professions, especially natural resources. Environmental and engineering departments at many civil and military airports also use GIS to aid in planning new construction and future development. These same techniques can be applied at airports to create maps that visually portray the occurrence and location of wildlife hazardous to aircraft. At Seymour Johnson Air Force Base in North Carolina, USDA Wildlife Services uses this technology to analyze and display wildlife activity on grid maps. Wildlife observations are maintained in a database that is linked to the facility GIS. Spatial and temporal distribution of species may be selected, and this information can be overlaid on maps that depict possible wildlife attractants (e.g., rivers or ponds). Resulting maps aid in wildlife hazard management and are easily interpreted by airport operations personnel. Archived material also can be examined to detect long-term trends that may be

hazardous. The use of GIS technology to create these maps is an efficient and concise process that provides information to a wide audience concerning wildlife hazards in the fast paced airport environment.

(7) Reported Bird Strikes at Down-State Illinois Airports

Michael W. Rapps, P.E., Rapps Engineering & Applied Science, 821 South Durkin Drive, Springfield, IL 62704 USA

Land-use restrictions in the vicinity of airports are increasingly employed as a means to reduce bird strikes on aircraft. Yet, in the absence of controlled studies, the link between land usage and bird strikes is largely anecdotal. In seeking a connection between bird strikes and land use, the records of reported bird strikes from the years 1990-2001 were examined for 28 airports in down-state Illinois. For each airport it was noted whether land use within 6 miles of the airports included large bodies of water or wetlands, wildlife sanctuaries, golf courses, landfills, shopping venues with food concessions, or croplands. Because most bird strikes reportedly occur in the course of aircraft takeoffs and ascent or aircraft descent and landing, aircraft operations (defined as takeoffs or landings) are taken to represent opportunities for bird strikes such as might be linked to surrounding land uses. This allows the creation of a comparative statistic for the number of aircraft operations per reported bird strike. Because bird strike reports are voluntary, no attempt is made to formulate a predictive statistic. However, it is noted that the largely rural down-state Illinois airports report bird strikes (as a function of aircraft operations) far less frequently than is indicated by a comparative national statistic. The bird strike reporting frequency among the studied down-state Illinois airports is noticeably greater at the more heavily trafficked airports. It is found that land uses in the vicinity of the 28 airports that were examined do not represent an obvious linkage to bird strikes reported at those airports.

(8) Influence of the Bash Phase II Program on Reduction of Birdstrikes to Air Mobility Command Aircraft

Brian D. Oswalt, 319 ARW/SEF, Grand Forks AFB, ND 58201 USA

The purpose of the proposed study was to examine the reduction of birdstrikes to aircraft during the Bird Aircraft Strike Hazard (BASH) Phase II flight restriction periods and their affect on Air Mobility Command (AMC) and the U.S. Air Force (USAF). This study sampled the entire population of AMC airfields with BASH Phase II flight restrictions. The test period consisted of damaging birdstrike data collected 5 years before BASH Phase II operations began (1991-1995), and the years during BASH Phase II (1996-2000). It was hypothesized that since the implementation of BASH Phase II flight restrictions, there had been no significant reduction to the number of birdstrikes on AMC aircraft. During the period before BASH Phase II flight restrictions (1991-1995), AMC had a total of 35 reported damaging birdstrikes during the historic Phase II periods. Damaging birdstrikes increased in AMC to 44 from 1996-2000, when Phase II flight restrictions were imposed at these bases. The study concluded that not only was there no significant reduction in damaging birdstrikes, there was actually a 21% increase of damaging birdstrikes, AMC wide. To date, there has been no known test of the USAF BASH Phase II program to determine if it has been successful.

(9) Development and Maintenance of Airport Wildlife Hazard Mitigation Website for the FAA and its Use as a Communication Tool

Dr. Archie M. Dickey, Environmental Sciences, and Allen R. Newman, Computer Sciences, Embry-Riddle Aeronautical University, 3200 Willow Creek Road, Prescott, AZ 86301 USA

The Federal Aviation Administration's (FAA) William J. Hughes Technical Center has contracted with Embry-Riddle Aeronautical University-Prescott to develop and maintain a website dealing with a variety of issues and concerns related to wildlife and aviation. Our goal is to increase the transfer of information among biologists and the aviation community regarding the nature of wildlife hazards to aircraft and methods for reducing these hazards. The site has an on-line wildlife strike report form (FAA Form 5200-7) which also

enables users submitting strike reports to access information on wildlife management, bird identification, FAA guidelines, and strike statistics. A query system has been developed that allows authorized airport and air carrier personnel to access selected components of the FAA National Wildlife Strike Database. Other user services available at the website are current news, upcoming meetings and training, available jobs, and discussion/forum sections.

(10) Progress Report on Development of a Terminal Area Bird Detection and Monitoring System using the ASR-9

Seth Troxel, Beth Echels, Will Pughe, and Mark Weber, MIT Lincoln Laboratory, 244 Wood Street, Lexington, MA 02420-9185 USA

Arthur Levy, Federal Aviation Administration, 800 Independence Ave. SW, Washington, DC 20591 USA

Lincoln Laboratory has been tasked by the FAA to investigate utilization of existing terminal area surveillance radars as the basis for a real-time, automated bird hazard advisory system for the immediate airport vicinity. With its on-airport siting and rapid scan rate, the ASR-9 is a logical choice as the primary sensor for the Terminal Avian Hazard Advisory System (TAHAS). Using multi-dimensional image processing and fuzzy logic techniques, a bird-flock detection module that operates on ASR-9 data has been developed and was described at last year's conference. Refinements to the flock detection module are ongoing. Recent efforts have focused on detection of individual or small groups of birds. A measurement program was undertaken during 2 weeks in November 2001 at Austin-Bergstrom Airport, TX to ascertain the ability of the ASR-9 to detect individual or small groups of birds in the immediate airport vicinity. Simultaneous measurements provided by Geo-Marine's X-band Mobile Avian Radar System (MARS) were used to identify periods of bird and bat activity that were subsequently examined in the ASR-9 data. High-speed animations of ASR-9 reflectivity data revealed considerable numbers of individual bird-echo tracks in addition to the larger bird flock movements. Given this encouraging result, a real-time, high-update bird tracking module that extracts and displays individual bird tracks from ASR-9 data is being developed. An initial version of the tracking module has been completed and is described along with examples of its performance.

(11) A Progression of Avian Radar Studies at Airfields

Edward J. Zakrajsek, Carolyn Matkovich, and Andreas Smith, Geo-Marine, Inc. Avian Research Laboratory, 3160 Airport Road, Panama City, FL 32405 USA

We used our Mobile Avian Radar Systems on two different projects this past year. A study at Robins Air Force Base, Georgia, used the old configuration, with a vertical-scanning radar and our image-processing technique. A study at Vancouver International Airport, B.C. used the new configuration with both vertical and surveillance radars and our new radar data processing technique. The Robins study was a preliminary assessment of seasonal bird-hazards, especially regarding the altitude distribution of birds near the airfield. Data was collected. The Vancouver study was a preliminary survey and system evaluation for the development of a real-time, dedicated Airport Bird Detection System. These two studies highlight the capabilities of avian radar systems and the improvements made over the past year. They also hint at the direction that avian radar systems are evolving as tools for managing bird hazards to aircraft.

(12) Advances in Radar Technology for Bird Strike Risk Assessment

T. Adam Kelly, Ronald Merritt, Ronald L. White, Mark Howera, and Timothy West, Geo-Marine, Inc., Avian Research Laboratory, 3160 Airport Road, Panama City, FL 32405 USA

Since the 2001 BSC meeting in Calgary, Geo-Marine, Inc. has made dramatic advances in the development of avian radar systems. The Mobile Avian Radar System (MARS) has undergone major revisions. New radar processor cards provide the computer workstations with higher resolution data than was previously possible. The system now incorporates both horizontal- and vertical-scanning radars. The vertical scanning radar

antenna now includes a shield to reduce side-lobe interference. Significant improvements have been made in ground clutter and weather reduction algorithms. The system has been tested for use in real-time monitoring of bird hazards on airports. GMI is currently working with Transport Canada to develop a dedicated, on-airport, 3-dimensional radar for real-time bird hazard assessments. The new technology makes the real-time radar monitoring of bird hazards at civil and military airports, military ranges, and landfills possible.

(13) Bird Detection and Radar Wind Profilers

Scott McLaughlin, Applied Technologies, Inc., 1120 Delaware Avenue, Longmont, CO 80501 USA

Radar wind profilers (RWPs) are a very sensitive class of operational and research-grade meteorological radars designed specifically to detect clear air turbulence in the atmosphere. These systems have been designed with frequencies ranging from 50 MHz to 3 GHz and antenna sizes from about 1 m to >1 ha. Unlike NEXRAD systems, the antennas do not move or scan but rather are stationary and use phase-shifter arrangements to point the beam. Using the Doppler-shifted backscatter return, winds profiles can be measured from near the ground to as high as 20 km in 5- to 60-minute intervals. RWPs have been used now for over 10 years for operational weather forecasting and atmospheric research, with upwards of a hundred or so operating throughout the USA. From the beginning, it became obvious that birds flying at various altitudes could interfere with the gathering of quality wind data. In particular during bird migration events in the spring and fall, significant amounts of wind data can be lost. Algorithms have been developed to screen out contaminated data, but the contaminated data, potentially useful to ornithologists, is not currently further processed. This paper will present information about various types of clear-air radar wind profilers, how they operate, the data products they produce, current users of RWP data, and the possible use of RWP data in the bird strike community.

(14) Development of a Portable Bird Detection Radar for Airports

Michel Hovan, Federal Aviation Administration, Airport Technology R&D Branch, William J. Hughes FAA Technical Center, AAR-410, Pomona, NJ 08405 USA

The development of a prototype portable bird detection radar for airports and airfields will be presented. This prototype radar is currently being developed under a partnership between the U.S. Air Force and the FAA, and is being funded under the U.S. Air Force Dual Use Science and Technology (DUST) program. Overview of the program will be given, and detailed specifications of the radar unit, and planned tests at a commercial airport will be presented. Future Plans for an integration of this type of radar into a real-time airport bird strike advisory system will be presented as well.

(15) Need for Certification Program for Persons Conducting Wildlife Hazard Management Activities at airports

John Ostrom, 4300 Glumack Drive, Suite 3000, Minneapolis-St. Paul International Airport, St. Paul, MN 55111 USA

With the complexity of tools, information and resources available to airports today, there comes a need for standardization for those persons involved in Airport Wildlife Hazard Management. One approach to standardization would be the creation of a multi-level certification program to provide the basic necessary information, training and resources to anyone involved in Airport Wildlife Hazard Management. In order to create and manage this program, the basic structure of Bird Strike Committee USA (BSC USA) would need to evolve into a more formal organization. This reorganization would create the foundation for BSC USA to provide the necessary management structure and tools to develop and maintain a certification program as well as a variety of services and resources that involve wildlife management at airports.

(16) Even with Good Equipment, Experienced Manpower is Necessary

Nigel Horton, NH Bird Management, P.O. Box 498, Guildford GU2 9WP UK

Maximized efficiency and quality assurance of equipment is essential to both the manufacturer and the end-user. Quite uniquely, one UK manufacturer of bird control equipment sought the views of the aerodrome bird control staff who used it. A simple tick-box questionnaire, designed by an independent biologist, was sent to each aerodrome and 37 returned completed forms, representing about half of known users in the UK. A simple subjective analysis of these produced some unexpected results that are presented here. The survey was not dissimilar to the original trials of bird distress calls on RAF airfields undertaken during the 1960's, thus allowing some direct comparison. The early playback equipment was not as robust as that currently available; the distress calls were not digitally enhanced in the 1960s; call playback fidelity should, therefore, be clearer and the response improved over the intervening 30 years. Grouping all the returns, the latest results appeared to show very much less efficiency than was found in the original RAF trials, in some species by as much as 50%. However, when the returns were analyzed by type of bird control organization on the aerodrome, the results revealed that the problem was not with the distress call or the equipment, but rested with who was using it on the aerodrome. It highlights yet again, whether the problem is gulls in the UK or rheas in South America, that equipment is ultimately only as good as the person using it. The fact that one group can use it successfully and efficiently, and reports the same to the manufacturer, is good assurance; the other groups have to rethink their strategy.

(17) Increasing Air Safety at Eglin Air Force Base through Vulture Roost Dispersal

John S. Humphrey, USDA, Wildlife Services, National Wildlife Research Center, 2820 East University Avenue, Gainesville, FL 32641 USA

Forested wetlands provide attractive roost sites for black vultures (*Coragyps atratus*) and turkey vultures (*Cathartes aura*). Vultures entering and departing roosts, however, can create hazardous conditions for pilots arriving and departing nearby airports because vultures often use the same air column as aircraft. This was the case for Eglin Air Force Base and co-located Okaloosa Regional Airport in Niceville, Florida where 260 vultures roosted in nearby Turkey Creek Nature Trail. We evaluated the effectiveness of suspending a taxidermic vulture effigy in the roost, augmented by periodic use of a handheld laser management options to alleviate these aviation safety problems. The laser was used during first light and dusk on the 2nd and 3rd treatment day. Vulture numbers decreased 41% within 3 days and 100% 4 days after installation of the stimulus. Hanging a vulture effigy from a location within the roost creates an unfavorable roosting environment for vultures and offers a simple, effective means to manage problem roosts. The use of the handheld laser further decreases the desirability of the roost and quite possibly the time it takes to disperse the roost. In this study, dispersal of the vulture roost effectively resolved a potentially dangerous situation. In other cases however, dispersal of roosting birds may not decrease bird strike hazards.

(18) A New Technology to Repel Birds: The High-Intensity Acoustic Bird Dispersion System (HIABDS)

Xi Baoshu, Zhou Mingjun, and Wang Jingqun, Tsinghua University, Beijing, China
Richard A. Dolbeer, USDA, Wildlife Services and Thomas W. Seamans, USDA, National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870 USA

A High-intensity Acoustic Bird Dispersion System (HIABDS), invented by Professor Xi Baoshu, is a new nonlethal device for dispersing birds from airports and other locations. The device employs a unique electro-pneumatic loudspeaker which can amplify recorded wildlife vocalizations or artificial sounds of varying frequencies to high power levels and project them over long distances. The sound pressure reaches 135 dB at 10-m distance. In China, HIABDS is being used at Lanzhou Airport to disperse upland buzzards (*Buteo hemilasius*), whose numbers declined by 80% after 1 year of deployment. During 2001-2002, HIABDS was

used at Tianjin Binhai International Airport to keep over 1,000 crows outside of runway area and at Beijing Capital International Airport during a visit by President George W. Bush. In the USA, field evaluations of HIABDS were conducted in Ohio at Burke Lakefront Airport and other sites in 2001. We recorded the response of various bird species to 6 sounds (synthetic and recorded distress calls) broadcast from the HIABDS. Turkey vultures (*Cathartes aura*) exposed to sounds from the HIABDS at 200 m dispersed from a nighttime roost, but 12 of 13 vulture groups were unaffected while soaring or perched during the day. In contrast to vultures, red-tailed hawks (*Buteo jamaicensis*) dispersed in 18 of 24 exposures to sound from the HIABDS. All 15 flocks of gulls (*Larus* spp.) within 300 m of the HIABDS dispersed whereas none of 11 flocks beyond 300 m dispersed. For Canada geese (*Branta canadensis*), 3 of 5 tests with a goose distress call caused dispersal whereas none of 8 tests with other sounds generated any reaction, even at 75 m. Mallards (*Anas platyrhynchos*) showed no reaction to any of 4 sounds in 14 of 15 tests within 300 m. European starlings (*Sturnus vulgaris*) showed a strong dispersal response to a synthetic clicking sound when broadcast within 300 m of the flock. Caspian terns (*Sterna caspia*) ignored the 4 sounds evaluated. In conclusion, sounds broadcast from the HIABDS were effective in dispersing certain species, depending on the sound used and distance of birds, whereas other species were generally unresponsive to any sounds at any distance. These findings point out the complexity of dispersing birds depending on species, behavior, and time of year. Our findings indicate that the HIABDS can be used to disperse certain birds and that such a system might be useful as part of an integrated wildlife hazard management program for airports. We recommend that a HIABDS-equipped vehicle be provided to one or more airports in North America for evaluation by the airport's wildlife control officers. This will allow for a practical evaluation of the HIABDS under field conditions and further assess the performance of the system.

(19) Emergency Wildlife Management Response to Protect Evidence Associated with the Terrorist Attack on the World Trade Center, New York City

Richard B. Chipman, Kenneth J. Preusser, Justin T. Gansowski, Carl P. Cranker III, Daniel P. Sullivan, USDA, Wildlife Services, 1930 Route 9, Castleton, NY 12033 USA

Richard A. Dolbeer, USDA, Wildlife Services, 6100 Columbus Avenue, Sandusky, OH 44870 USA

Thomas A. Seamans, USDA, National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870 USA

Laura C. Francoeur, Port Authority of New York and New Jersey, John F. Kennedy International Airport, Building 14, Jamaica, New York 11430 USA

Human-wildlife conflicts arise under a variety of circumstances and working environments. No one could have predicted the unique working environment created by events surrounding 11 September 2001. At the request of the New York City Police Department (NYPD), the Port Authority of New York and New Jersey (PANYNJ) and the New York State Department of Environmental Conservation, a team of USDA, APHIS, Wildlife Services (WS) biologists mobilized in less than 24 hours to assist officials from the NYPD, PANYNJ and the Federal Bureau of Investigation in managing birds and rodents impacting the recovery of evidence as a result of the terrorist attacks on the World Trade Center. During the 9-month recovery effort from September 2001 to June 2002, more than 1.7 million tons of debris were shipped from "Ground Zero" in Manhattan, to a high-security crime scene at Fresh Kills landfill (FKL), Staten Island, New York. Close to a billion pieces of debris were sorted by law enforcement officials to recover personal effects, human remains and other evidence to document the crime and identify victims as part of the largest forensic investigation in the history of the USA. Within days of bringing debris to FKL (which had closed in February 2001 and was reopened after September 11), more than 2,600 gulls (*Larus* spp.) were landing and harassing law enforcement officials, making an already difficult work environment more difficult and creating a concern that evidence would be lost to birds. FKL has been a traditional feeding and loafing site for gulls and other birds (e.g., WS biologists estimated at least 100,000 gulls at FKL in November 1986), indicating a very real threat that local bird populations could increase significantly as the operation progressed. To address this unique wildlife damage management problem, WS implemented an integrated bird and rodent damage management program that eventually involved more than 66 biologists from 24 states. The goal was to reduce the impact of gulls, crows

(*Corvus* spp.), house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) on law enforcement personnel, equipment and evidence collection. A zero-tolerance policy for gulls and crows landing on the working face was implemented to meet our objective of minimizing the risk of loss of evidence to wildlife. A combination of population surveys and direct management activities targeting gulls and crows was initiated 12-14 hours/day, 7 days/week using visual and noise deterrents including pyrotechnics, mylar tape, human and dead-bird effigies, lasers, paint-ball guns, and lethal removal of a limited number of birds. In addition, bi-weekly rodent surveys with snap traps were conducted to document population trends and explore the need for rodent control on site. We describe the evidence recovery process; the subsequent need, implementation, and efficacy of a bird and rodent management program to protect forensic evidence; and key lessons learned regarding an emergency response program to manage wildlife. Our findings are relevant to airports, waste management facilities, and other sites attempting to establish zero tolerance for birds and other wildlife that are hazardous to human health and safety.

(20) Strides in Bird Hazard Control at Entebbe International Airport

Gloria Kirabo Bitebekezi, Civil Aviation Authority, P.O Box 5536 Kampala, Uganda

The location of Entebbe International Airport within the Entebbe peninsula bird sanctuary would make it one of the most bird-strike prone airports in the world. However the airport actually has a relatively clean strike record. Since 1998, the number of bird strike incidents that caused damage to aircraft has been on the decline. This paper illustrates the methods used at Entebbe International Airport and their effectiveness in controlling different species of birds.

(21) Bird Hazard Control Program at Panama Airports

Esteban Godinez, Misión de Cooperación Técnica de la OACI en Panamá, Apartado 7501, Panamá 5, República de Panamá

ICAO Bird Information System (IBIS) has been conducted at Panama airports since 1996. Bird strike notifications, technical reports as well as wildlife control procedures have been developing as essential roles of the National Bird Hazard Committee and its Wildlife Limitation Programs. Sixty-four (64) bird strikes with different aircraft were recorded and sent to ICAO so far, while an additional 154 collisions (71%) were not reported to ICAO because of the failure to determine the aircraft involved. Among the birds struck at airports, the most outstanding species are the common barn owl (*Tyto alba*) and the black vulture (*Coragyps atratus*). One black vulture was responsible for the first air crash in Panama, on 27 January 2000, which resulted in two human fatalities. Other important large bird species are the turkey vulture (*Cathartes aura*), the crested caracara (*Polyborus plancus*) and the great egret (*Casmerodius albus*). Considering the large numbers of birds near the airports, especially during the raptor migration period, the incidence of bird impacts would be much greater, mostly during the rainy season. The wildlife control programs at the principal international airports are established through the Bird Hazard Airport Committees. Bird dispersal methods used include pyrotechnics (shot-launchers and local fireworks) and gas cannons. Removal methods include toxicants such as rodenticides and insecticides, and firearms (mostly .22 caliber rifles and pellets air rifles).

(22) Evaluation and Mitigation of Bird Hazards in Ex-Vaso de Texcoco: The Proposed Site of a New International Airport for Mexico City

Edward C. Cleary, Federal Aviation Administration, 800 Independence Ave. SW, Washington, DC 20591 USA
Richard A. Dolbeer, USDA, Wildlife Services, 6100 Columbus Ave., Sandusky, Ohio, 44870 USA
Patricia Ramirez Bastida, Universidad Nacional Autonoma de Mexico, Avenida 602 #161, Mexico City 15620 Mexico

If Mexico is to meet increasing demands for air travel, a new international airport for Mexico City must be constructed. At the request of the Secretaria de Comunicaciones y Transportes (SCT), we evaluated Ex-Vaso

de Texcoco (EVT), one of several sites considered for construction of the new airport, to determine if birds would pose an unacceptable risk to aircraft. Aerial (by helicopter) and ground surveys were conducted on 6 occasions during fall and winter from 1996-2002 to census birds and evaluate aquatic habitats at EVT and other locations in the Valley of Mexico. Total populations estimates for waterfowl and shorebirds using EVT ranged from 29,000 to 77,000 (mean = 48,300). The majority of birds observed (70%) were south of the Carretera Peñon Texcoco (CPT), the highway that bisects EVT. The wetlands north of the CPT contained about 3% of the ducks and 3% of the coots in the Mexican Highland's wintering population. We concluded that an airport could be constructed in EVT north of the CPT without a significant bird-strike threat, provided habitats attractive to birds were not allowed within 3.2 km of the airport's aircraft movement areas, and conditions were not created that would encourage birds to over-fly the airport or move into or through the airport's approach/departure airspace. We recommended that wetland losses due to airport construction north of CPT should be off set by enhancing and expanding wetlands identified elsewhere in the Valley of Mexico to ensure no net loss of wetlands within the valley. Our investigation of bird issues was only one of numerous technical and economic studies conducted regarding the site selection and design of the new airport for Mexico City. Based on the conclusions of all these studies, of which birds were only one factor, an area in EVT north of CPT was selected in October 2001 as the site for the new airport. Our study demonstrated the importance of including the evaluation of bird hazards in the site-selection and design phases for any airport.

(23) The Evolution of Transport Canada's Wildlife Management and Planning Program

Bruce MacKinnon and Kristi Russell, Transport Canada, Civil Aviation, 330 Sparks Street, Tower C, Ottawa, Ontario, K1A 0N8 Canada

As a follow-up to a paper presented at International Bird Strike Committee meeting #23 in 1996, discussing Transport Canada's emphasis on education and awareness programs as a means to reduce bird hazards to aircraft, this paper will describe significant changes that have occurred in Canada since that time. The 1994 Government of Canada National Airports Policy led to the devolution of Canada's major airports. Private sector airport authorities now operate these airports and Transport Canada's focus has shifted from management by policy to one of regulatory oversight. In addition to building on the awareness program that was in place in 1994, Transport Canada is in the final stages of introducing a performance-based regulation for Wildlife Management and Planning at applicable Canadian airports. Key components of the regulatory package are: a requirement for developing a risk assessment and management plan; an obligation to report all wildlife incidents; an obligation to provide training to wildlife control staff; and an obligation to establish a reporting and communication network. The applicability of the regulation is based on types of aircraft and number of operations, airport location and historical risk, and the presence of incompatible land-use activities.

(24) Wildlife Hazard Management in Micronesia: Aviation Safety in Uncharted Territory

Daniel S. Vice, USDA, Wildlife Services, 1060 Route 16, Suite 103C, Barrigada Heights, Guam 96913

The islands of Micronesia support small, but growing, commercial and military aviation routes. A developing tourism industry, coupled with increased demands for military training sites, is bringing aviation traffic to remote and occasionally primitive island settings. While flight volumes are low relative to mainland settings, the nature of aviation in the islands is that of self-sufficiency and minimal infrastructure, which creates difficult flight situations. Pilots flying island routes face numerous challenges, including wildlife hazards that are generally unmitigated. Although major infrastructure and safety improvements have been made across many of the civilian airports in Micronesia, the impact of wildlife on aviation safety has not been thoroughly addressed; several CFR 139-certificated airfields lack basic information regarding the hazards specific to each island and most operate with no operational hazard management activities. Migratory shorebirds, resident sea birds, and resident mammals create the most severe hazards, while introduced and native forest birds present increasing hazards in some locations. This presentation will review what is known about wildlife hazards in the tropical Pacific and provide recommendations for future management actions.

(25) Avian Hazard Control in Brazil: Essential Role of the Aeronautical Accidents Prevention and Investigation Center - CENIPA

Major Luiz Cláudio Magalhães Bastos, Brazilian Aeronautical Accident Prevention and Investigation Center, CENIPA SHIS, QI 05, VI COMAR, Lago Sul, Brasília, DF, 71.615-600 Brazil

Brazil built one of the world's largest aeronautical infrastructures. The airport net is distributed along its vast territory, which shows a tremendous ecosystem variety. Having a large civilian aircraft fleet and also running second after Venezuela in catalogued bird species, Brazil has had problems related to bird strikes. Nevertheless, Brazil is made up of 26 States plus the Federal District. Thus, besides the Union Government, each state holds its own government structure. The states are divided into counties that also have their own administrative structure. The jurisdiction of each level of government is established by the Federal Constitution, laws and others legal acts. Therefore, solutions for bird strike hazards, whose root causes are spread into all three government levels, encompass many institutions and require an orchestrated coordination. The paper comments on aspects of the lead role played by CENIPA, the main organization of the Brazilian flight safety system, to keep the avian hazard under control in Brazil. Among others, the following measures are considered in the paper: a) the organization and outcomes of the first national meeting about bird strike hazard control last year; b) the issue of experts report showing agreement or not, by the aeronautical authority, with the establishment of potential bird attractive activities in the vicinities of airports; c) the management and application of the national bird strike database; and d) the elaboration of an avian hazard control manual to be used by airports administrators, aircraft operators, waste facilities managers and mayors.

(26) The Brazilian Civil Aviation Department (DAC) and Bird Strike Control in Brazil

Jandrisson Gurgel do Amaral Jr., Brazilian Air Force Major, Brazilian Civil Aviation Department, DAC Air Accident Investigation and Prevention Division, DIPAA, Member of Brazilian Committee for Avian Hazard Control, Civil Aviation Department (DAC) Representative, R. Santa Luzia, 651/1001, CEP 22041-010, Rio de Janeiro, RJ, Brazil

The subject addressed in this paper is the participation of Brazilian Civil Aviation Department (DAC), and more specifically the Air Accident Investigation and Prevention Division (DIPAA) in the efforts regarding civil aircraft bird strike control in Brazil. In order to successfully achieve this intent, this paper will briefly introduce the recordings of civil aircraft bird collision registered in Brazilian Civil Aviation Department, reported by the civil aviation community (airliners, air operators, airport staff, general aviation personnel, ATC, etc.). In addition, the paper will outline the dimension of the bird strike hazard encountered by the civil fleet operating in Brazilian skies as well as in major Brazilian airfields. Finally, the paper will provide a status update of some recent civil aviation bird strike incidents in Brazil. The Contributing Factors behind the scenes of these incidents are identified, and the Safety Recommendations issued are considered.

(27) Bird Strikes in Courts: The Genoa Case

Dr. Valter Battistoni, ENAC, Ente Nazionale per l'Aviazione Civile, Direzione Circostrizione Aeroportuale, Alghero; Bird Strike Committee Italy, Direzione Circostrizione Aeroportuale, Aeroporto Civile, 07040 S. Maria La Palma, Italy

There have not been many court cases, be it criminal or civil, concerning accidents, or even compensation for damages, following bird strikes. Generally, those involved prefer to reach an agreement out of court. The first court sentence in Italy on this subject was pronounced by the Civil Court of Genoa in 2001. The carrier had sued a number of entities (Ministry of Transport, Airport Operator, Air Traffic Control Agency) for damages resulting from a multiple impact between a BAE 146 and a flock of gulls (*Larus* sp.) that occurred on 7 June 1989 at Genoa Airport. On that occasion the aircraft managed to return to the parking stand, severely damaged with three engines out of order. This presentation describes the positions of the parties concerned and the judges' conclusions – conclusions that might obviously be modified following an appeal.

(28) Canada Goose Population Management at the Minneapolis-St. Paul International and Downtown St. Paul Airports

James A. Cooper, Department of Fisheries, Wildlife, and Conservation Biology, College of Natural Resources, 1980 Folwell Avenue, University of Minnesota, St. Paul, MN 55108 USA

A Canada goose (*Branta canadensis*) control program was initiated at the Minneapolis-St. Paul International Airport (MSP) in 1984, and at the Downtown St. Paul Airport (STP) in 1994. Flightless geese >16 km from these airports were trapped (MSP 1,734; STP 1,397), neckbanded (MSP 1,047; STP 502), and observed and counted weekly in fall at 22 and 6 locations >5 km from MSP and STP, respectively. Efficacy was also measured by observing fall goose flights through the operations airspace in 1984-1987 and 1998-2001 (MSP), and 1994-2001 (STP). Based on neckband origin of birds observed >2 km from the airfields, 3,338 flightless geese were removed from 26 MSP and 2,972 from 14 STP sites. From 1990-2001, 641 nests containing 3,604 eggs were destroyed and 458 breeding geese shot on 7 MSP wetlands. MSP populations declined significantly ($P<0.01$) from 61 (1984) to 17 geese/site (1988), and remained significantly lower in all years but 2001. MSP airspace use declined ($P<0.01$) from 25 (1984) to 4 birds/h (1986). During the 1998-2001 period, airspace counts were significantly ($P<0.05$) greater than the 1984 level in the warm falls of 1998 and 2001. December flights increased from 0 (1984-1987) to 120/h (2001). STP populations declined ($P<0.05$) between 1994 and 2001. STP airspace geese dropped significantly ($P<0.01$), from 126 to 27/h. Given a 1984-2001 projected Twin Cities breeding goose increase of 10X and an actual statewide expansion of 9X in Minnesota, the lack of growth in geese at both airports is strong evidence of program effectiveness. A negative correlation ($P<0.05$) was found between geese >2 km of MSP and airspace flights indicating that bird behavior influences flight frequency. MSP goose behavior were recorded during periods of low (1984-1987) and high (1998-2001) harassment by Airport Operations personnel. Birds flew higher and came from more directions with greater hazing, whereas hazing had no effect on the number geese in the airspace or the proportion landing on the Aircraft Operating Area.

(29) Monte-Carlo Simulation of Birdstrike to Support Rule Making for Large Birds

Dr. Julian M. Reed, Rolls-Royce plc, P.O. Box 31, Derby, DE24 8BJ, England, UK

A clear need was established by the aero-engine manufacturers and the certifying authorities for a re-assessment of the published rules governing engine certification for large flocking birds. A task group was set up to address this need at the beginning of 2000. Early in this program, it was determined that a statistical approach to the rule making was required and the Monte-Carlo technique was proposed and accepted. This paper discusses the implementation of the Monte-Carlo technique to simulate bird strike events from the Rolls-Royce viewpoint and describes the various refinements that have been made in order to ensure an adequate comparison with observed service data. Subsequent to this benchmarking process, the results from the analysis have been used to calculate engine shut-down rates for various proposed large bird rule scenarios ultimately leading to the acceptance of a new flocking bird certification requirement for engines of inlet area of 2.5m² and above. In addition, the analysis has been used extensively within Rolls-Royce to conduct theoretical bird strike studies.

(30) Aircraft Engines and Large Flocking Birds

Richard Parker, Pratt & Whitney, 400 Main Street, M/S #162-24, East Hartford, CT 06108 USA

This paper will present a summary of the results of the ARAC (engine) Bird Ingestion Phase II rule making effort. The effort was to evaluate the hazard to transport category aircraft, of large flocking birds, and to revise the engine certification requirements as appropriate. The paper will discuss the revision to engine certification requirements. It will also discuss the recommendation of the task group regarding the importance of continuing effort for bird control at the airport.

(31) Potential of Grass-Endophytes as a Bird Deterrent: Concept Testing with Canada Geese

Chris G. L. Pennell, and Phil Rolston, AgResearch Limited, Canterbury Agriculture & Science Centre, P.O. Box 60, Lincoln, Canterbury, New Zealand

Problems caused by birds in the agricultural, horticultural, recreational and the aviation industries are escalating world wide as man develops environments that are attractive to birds. Chemical repellents, bird scarers, and exclusion netting are being used to keep birds away by taste, fright and containment. Habitat management using grasses with selected endophytes may be a new tool for minimizing bird nuisance problems in these industries. Canada geese (*Branta Canadensis*) were offered selected ryegrass/endophyte *Neotyphodium lolii* seed and herbage to examine the effects of known endophyte alkaloids on their feeding behavior in 2000-2001. Forty geese were captured annually, contained in fenced areas by wing clipping and fed endophyte-free herbage and seed for a 3-week period prior to starting any treatments. In a choice 60;cafeteria61; and no choice feeding trial, geese consumed 30% less herbage containing the selected endophyte than the endophyte-free ryegrass herbage. In a seed feeding trial, the geese did not discriminate on first exposure between the endophyte-free seed and that containing the selected endophytes. However, on day two there was an 80% rejection of the seed containing the selected ryegrass/endophyte compared to the endophyte-free seed. The same rejection of 80% was observed after a 3-month endophyte-free feeding period, suggesting the rejection was a long-term, learned response or post-digestion feedback. The authors suggest continued research into this area will be of benefit in producing a living deterrent to birds by habitat modification. Learned-behavior response has been well documented in the past as the way forward. Farming grass/endophyte associations may add to mankind's armory of bird-control methodology.

(32) Aspects of the Feeding Ecology of Avifauna at an Inland Airport, South Africa

Ordino and Lettie Kok, Department of Zoology and Entomology, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa

Bloemfontein airport, situated in the central Free State, experiences the greatest number of bird-aircraft collisions at South African airports, relative to its (low) air traffic. In an attempt to rectify the situation, aspects of the feeding ecology of birds presenting a potential hazard at the airport were investigated. Plant surveys indicated that the study area can be classified as a dry *Cymbopogon* – *Themeda* veld type in a relatively good condition. Using 270 pitfall traps over a continuous period of 15 months, it was established that more than twice as many ground-living invertebrates, mainly insects, occurred in grass kept permanently short (average height 22 cm) compared to those in undisturbed long grass (average height 57 cm). Based on 4,843 birds from 51 species posing a threat to aviation and which were shot as part of an ongoing management programme extending over 11 years, medium-sized, ground-living birds such as crowned plovers (*Vanellus coronatus*), blacksmith plovers (*V. armatus*), whitewinged korhaans (*Eupodotis afraoides*), doublebanded coursers (*Smutsornis africanus*), spotted dikkops (*Burhinus capensis*), cattle egrets (*Bubulcus ibis*), Swainson's francolins (*Francolinus swainsonii*) and Orange River francolins (*F. levaillantoides*) dominated the local bird population. Crop and/or stomach analyses of these birds indicate that insects, mainly Isoptera but also Coleoptera and Orthoptera, collectively constitute their main food source. The Isoptera, more specifically the harvester termite (*Hodotermes mossambicus*), is, moreover, the only important prey taxon showing a conspicuous utilization peak during the relative food shortage of the dry season. A significant and sustained decrease in harvester termite numbers and activities was accomplished by administering Gauchotreated bait in disturbed grass areas, thereby reducing the availability of food and, hopefully, also bird numbers and bird-aircraft collisions. Implementation of a so-called long grass policy as a control strategy should have a similar effect.

(33) Assessing Bird Strike Hazards in Coastal Wetlands through Field Experiments

John Ledbetter, City of Santa Barbara, Planning Division, 630 Garden Street, Santa Barbara, CA 93112 USA
John Gray, URS Corporation, 130 Robin Hill Road, Suite 100, Goleta, CA 93117 USA

Santa Barbara Municipal Airport (SBA) is located in and adjacent to Goleta Slough, a large coastal salt marsh with limited tidal circulation. Various government and non-government agencies are pursuing a long-term project to restore the historic tidal circulation to the slough to improve ecological conditions. SBA recently completed a study to assess feasibility of conducting a controlled field experiment in the slough to evaluate the relationship between bird strike hazards and the presence of tidal and non-tidal wetlands near the airfield. The study indicated that a limited field experiment, in which new estuarine marsh areas are temporarily restored, would provide valuable empirical data on bird behavior and strike hazards. The study included provisions to ensure public safety during the experiment. The information from the field experiment will be used to determine the viability of a larger, long-term wetland restoration program in Goleta Slough, and appropriate bird strike hazard management actions. The need to conduct the Feasibility Study was an outgrowth of SBA's Master Plan update process, which began in 1991. The FAA's highest priority project identified in the Master Plan is to extend the Runway Safety Areas at either of the principal runway 7-25, which will necessarily impact the surrounding Goleta Slough coastal estuary. Over the last 10 years, SBA has worked closely with federal, state, and local regulatory agencies, as well as the environmental community, to develop a restoration plan for the slough that would provide the basis for the Runway Safety Area project mitigation requirements. As the Master Plan moved through the environmental assessment phase of the approval process, it became apparent that one of the main tenants of the slough plan, the restoration of tidal circulation, could potentially exacerbate the incidence of bird strikes. As the debate began to heat-up among the environmental community, USDA/Wildlife Services, SBA, and the FAA, the approval process ground to a halt. Finally, a compromise was struck in 1998 that bifurcated the Master Plan update process and the tidal restoration project. All parties agreed that prior to any further consideration of a tidal restoration project, scientific data was needed to better understand the relationship between coastal estuarine habitat, seasonal wetlands, and the incidence of bird strikes. Thus, the Master Plan update identified a mitigation plan without tidal restoration, which ultimately included a 4:1 replacement ratio for the seasonal wetlands impacted by the Runway Safety project. On a parallel tract, all parties also agreed to move forward in a deliberate and incremental fashion towards a managed experiment to test these relationships between habitats and bird strikes.

(34) Effects of Location and Phase of Flight on the Behavioral Responses of Birds to Aircraft: Preliminary Observations

T. C. Kelly, Department of Zoology and Animal Ecology, National University of Ireland Cork, Ireland
M. J. A. O' Callaghan, Department of Applied Mathematics, National University of Ireland, Cork, Ireland
P. D. Bourke, Statistics Department, National University of Ireland, Cork, Ireland
L. Buurma, Royal Netherlands Airforce, P.O. Box 20703, 2500ES Den Haag, Netherlands
R. Bolger, Aer Rianta, Dublin Airport, Dublin, Ireland

Based on an earlier classification of avoidance movements shown by birds to moving aircraft (Kelly *et al.* 2001), we have studied the evading maneuvers of the rook (*Corvus frugilegus*) in relation to the phase of flight of air traffic at Dublin Airport, Ireland. The percentage of individuals which did not show avoidance movements was almost identical for approach/landing and take-off /climb-out movements. However, the nature of the avoiding-response in relation to the phase of flight was different. Thus 78% of responses were "Simple" in the approach/landing flight phase whereas only 5% were in this category during take-off. On omitting the approach data, the difference between take-off and landing was less marked with only 18% being "Simple" in the latter. In the case of the energetically costly "Noose"-type avoidance maneuver, 23% of rooks showed this response to aircraft on take-off as compared to 13% that were landing. Interestingly while "Protean"-type responses were relatively infrequent, they appear to occur with equal frequency during both

landing and take-off movements. Recent evidence suggests that there are marked "Protean"-type responses by woodpigeons (*Columba palumbus*) to ascending aircraft during climb-out. These findings are discussed in relation to the numbers of birds present in the different phase of flight zones on the airfield, seasonal factors, and inter-specific differences in the nature and extent of the avoidance responses.

(35) Efficacy of Aircraft Landing Lights in Stimulating Avoidance Behavior in Birds

Bradley F. Blackwell and Glen E. Bernhardt, USDA, National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870 USA

A potential non-lethal technique to reduce bird-aircraft collisions, aircraft-mounted light, has been considered for nearly 3 decades, but has received no formal research as to its efficacy. We tested the hypothesis that during daylight hours birds exposed to an approaching vehicle exhibiting pulsing landing lights would react more quickly than birds experiencing an on-coming vehicle with non-pulsing (steady) or no lights (control). We used the Pulselite™ system (Precise Flight, Inc., Bend, Oregon, USA), an early recognition lighting system that allows an aircraft pilot to pulse the landing, taxi, or forward-facing recognition lights, and 2 General Electric sealed-beam 250-W aircraft landing lights. Using video, we quantified avoidance behavior by captive brown-headed cowbirds (*Molothrus ater*), Canada geese (*Branta Canadensis*), European starlings (*Sturnus vulgaris*), herring gulls (*Larus argentatus*), and mourning doves (*Zenaida macroura*) in separate experiments where captive birds were exposed to a vehicle fitted with the Pulselite™ system, and approaching at a consistent speed (33.5 m sec⁻¹). While most species showed no differential response to light treatments, brown-headed cowbird groups (9 groups per treatment, 6 birds per group) responded more quickly to pulse versus control treatments, equating to a greater mean [SE] distance of the approaching vehicle from mid-cage per reacting bird (control: 35.8 [9.7] m; pulse: 50.5 [10.9] m). However, in a subsequent experiment involving the exposure of brown-headed cowbirds to control, pulse, and steady-light treatments, we observed no statistical difference in response among treatment groups (6 groups per treatment; 6 birds per group). While 250-W landing lights, pulsed at 45 cycles min⁻¹, can influence avian behavior in response to an on-coming vehicle, the effects of the lights are inconsistent. We suggest that further research is needed to investigate avian response to specific ecologically relevant light wavelengths and a range of pulse frequencies.

(36) A Paradigm Shift in Bird Strike Prevention by the Israeli Air Force

Nicholas B. Carter, Border Collie Rescue, Inc., 886 State Road 26, Melrose FL 32666-3137 USA
Eyal Cohen, Commander of Control Units, Israeli Air Force, IAF Headquarters, Tel Aviv, Israel

Over the past 20 years, the Israeli Air Force (IAF) has focused attention in bird strike prevention on collisions between aircraft and migrating birds during low-level flight operations. Only in the last 2 years has the IAF begun to tackle the problem of reducing bird-aircraft collisions at or near airfields. A dramatic shift in thinking has led the IAF to initiate complete wildlife control programs at its airbases, featuring the employment of border collies and wildlife control officers to help eliminate the risk of wildlife collisions within the control zone (CTR) of each airfield. As a crucial component of this program, the IAF has initiated major changes in habitat management at airfields, eliminating agricultural initiatives and undergoing large-scale modifications in airfield maintenance practices. Additionally, the IAF has altered flight and ground operations where possible to attenuate the risk imposed by birds and has coordinated efforts within various departments at each airbase to address bird strike control issues. Awareness and the resolve to eliminate wildlife hazards at its airfields are key features to the IAF's new directive on bird strike prevention. Though still in its infancy, the IAF's new wildlife control program has already shown dramatic improvements in the reduction of bird strike hazards at airbases. In light of results achieved during this short time frame, it would indicate that use of border collies can be a highly effective mechanism for the IAF to combat bird strike problems. The most important result is obviously the bottom line – there have been no damaging bird strikes to aircraft since the commencement of the wildlife control program. Moreover, the threat of a serious bird strike has been greatly reduced by the elimination of larger birds from the airfields and a 3-km radius outside the airbases, as well as the overall reduction of major bird populations on the AOA.

(37) Management of Rodent Populations at Airports

Gary W. Witmer, USDA, National Wildlife Research Center, 4101 LaPorte Ave., Fort Collins, CO 80521 USA
Jessica W. Dewey, USDA, Wildlife Services, 4700 River Road, Unit 87, Riverdale, MD 20737 USA

Birds pose serious hazards at U.S. airports. Raptors are hazardous to aircraft safety due to their size, hunting behavior, and hovering/soaring habits. Abundant food sources, open space, and availability of perches at or near airports contribute to ideal hunting opportunities for many raptors. The ability to directly manage raptor populations is limited by the Migratory Bird Treaty Act. Reduction of small mammal populations at an airport may decrease raptor populations in the area and therefore, reduce the risk that raptors pose to aircraft. Rodents can be managed by population management or by habitat management. Reduction of small rodent populations can be achieved through a variety of methods, including the use of rodenticides. Zinc phosphide, a rodenticide on a grain bait, was found to be very efficacious in rodent population reduction at a USA airport, but provided only a short-term solution. We discuss the use of zinc phosphide baits in field settings, including important steps and precautions in use. We also present preliminary data on differences in rodent populations in different habitats or varying land uses at or near airports. The maintenance of low vegetation by mowing or cattle grazing resulted in lower rodent populations. Certain crops supported fewer rodents than grasslands. We will present examples of potential complications and unexpected results that have occurred when managers tried to emphasize or de-emphasize one group of species at the expense of another.

(38) Efficacy of Translocation of Red-tailed Hawks from Airports

Laurence M. Schafer, USDA, Wildlife Services, AMC Building, Room 241, P.O. Box 66142, Chicago, IL 60666 USA

John L. Cummings, USDA, National Wildlife Research Center, 4101 LaPorte Ave., Ft Collins, CO 80521 USA

John A. Yunger, Environmental Biology Program, Governors State University, University Park, IL 60466 USA

Kirk E. Gustad, USDA, Wildlife Services, 2869 Via Verde Drive, Springfield, IL 62703-4325 USA

Raptor translocation from airport environments is a management strategy that has been recommended and used in attempts to reduce aircraft strikes. However, supportive data are lacking about optimal translocation distance and direction, return rate, post-translocation fate and overall efficacy of the technique. We conducted a study from 1 December 1999 to 28 February 2002, which included satellite telemetry, to address these issues of raptor translocation at a Midwest Airport. Two hundred and fourteen red-tailed hawks (*Buteo jamaicensis*) were translocated to 12 sites in Illinois, between 59 and 242 km from the airport. Thirty-four after-hatch-year (AHY) individuals were fitted with satellite (PTT, $n = 22$) or VHF ($n = 12$) transmitters. As of 31 October 2001, 34 (15.9%) of the 214 red-tailed hawks returned to the airport. We compared the return rate among age class, period of translocation (i.e., breeding, fall and spring migrations, and over wintering), direction of translocation, and translocation distance. Only 3.2% (3 of 93) of hatch-year (HY) individuals returned, whereas 25.6% (31 of 121) of AHY birds returned ($P < 0.001$). HY red-tailed hawks were also easiest to capture and least likely to return. No differences among the other factors were identified. The mean number of days to return was 108.6, range 2-369. Satellite data indicated that 19 of the 22 (86.3%) PTT-fitted birds dispersed from the release site within 5 days, suggesting that translocation did not result in an over-saturation of individuals at the release sites. Use of airport habitats by PTT-fitted birds was significantly different ($P = 0.009$). However, this was probably due to a single individual being relocated on airports 43 of 125 times (34.4%). Excluding this individual eliminated statistical significance ($P = 0.576$). Although PTT-fitted birds used airport habitats greater than expected, average use was extremely low, $<2\%$.

(39) Translocating Common Nighthawks at McConnell Air Force Base, Kansas to Reduce Aircraft Strikes

John L. Cummings, Patrica A. Pochop, James E. Davis and Darryl L. York, USDA, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521 USA

McConnell Air Force Base (MAFB) experiences a unique bird/aircraft hazard problem with migrating common nighthawks (*Chordeiles minor*) from August-October. Nighthawks are the most commonly struck species at MAFB, representing about 38% of total reported bird/aircraft strikes and 82% of the strikes from August-October. Factors that contribute to an over abundance of nighthawks on MAFB are: abundant foraging opportunities in close proximity to the airfield, available roosting habitat for nighthawks on and around the airfield, the lack of a Bird Aircraft Strike Hazard program to address nighthawks, and the location of MAFB on a nighthawk migration route. Approaches for managing nighthawks on and around airfields are limited because of their nocturnal behavior, logistics, and an incomplete understanding of nighthawk behavior. At MAFB, we determined the number of nighthawks using the airfield; their foraging, loafing and roosting areas; and their feeding habits. Based on this information, we developed a management strategy to reduce the nighthawk hazard to aircraft. From August-October in 1999 and 2000, we recorded 540 and 920 observations, respectively, of nighthawks using the airfield. The number of individuals increased rapidly during August and September, reaching a peak between 9-14 September in 1999 and 27-30 September in 2000. During one 2-hour survey period each in 1999 and 2000, 37 and 59 nighthawks, respectively, were flushed from the airfield. Most nighthawk foraging activity at the airfield occurred between 1800-2200. Nighthawks started roosting on the airfield about 1800 with a peak between 2200-0200. Thirty-seven nighthawks collected during the study period consumed a variety of insects, consisting mostly of corn earworm moths (Noctuidae—47% of stomach contents) and beetles (Scarabaeidae). Insect sweeps of the airfield indicated a low density of these species of insects, suggesting that most nighthawks foraging activity occurred away from the airfield. Management of nighthawks on MAFB has been difficult because commonly used hazing techniques seem to be ineffective. Furthermore, nighthawks have a behavior of returning to the same roosting location after being flushed which can present an even greater risk to aircraft. We developed and evaluated a unique live-capture technique for nighthawks using the airfield for the purpose of evaluating nighthawk relocation. During 1999 and 2000, 215 nighthawks were captured and relocated to sites 44 km north and 88 km south from MAFB. Only one nighthawk returned to MAFB after being relocated 44 km north. The nighthawk returned after 11 days to within 100 m of its capture location. Relocation of nighthawks from MAFB in 1999 and 2000 reduced nighthawk/aircraft strikes from 9 in 1998 when no relocation was conducted to 0 in 1999 and 3 in 2000.

(40) A Small Pond Off-Airfield Provides More than Water

Nigel Horton, NH Bird Management, P.O. Box 498, Guildford GU2 9WP UK

Land use changes around aerodromes are becoming more problematical as conservation groups increasingly press for eco-friendly restorations, especially of water areas. Often the requirement is to encourage insects or plants or recreational use of such areas. However, these same beneficial features for biodiversity, can enhance the already considerable off-airfield bird attraction. A single case study illustrates the slow, generally unnoticed, development of a small water feature as an attraction to increasing numbers of birds and species over a period of about 10 years. This and a second study reveal how a "must feed the birds" mentality influences local bird populations. The extra food provided attracts even more birds that in turn attract more feeders; together, they increase the potential bird strike risk on the nearby aerodrome. Urbanization is increasing around aerodromes and balancing ponds for new business parks are not deep, functional holding tanks but made into ornamental water features. Here gently sloping lawns allow both staff and visitors easy access to feed the birds. By comparison, landfill sites are now relatively simple areas to control because the general public does not have access. Even when legislation exists to stop the deliberate feeding of birds, resistance groups form to oppose it and they employ direct action. This paper reviews one such site, the problems created and the law-breaking individuals with an attitude contrasting with common sense and logic. A major difficulty is that efficient airfield bird management appears to "handle" any problem from many of

these sites by ensuring that the airfield is not a safe haven for birds visiting them. As such, it is difficult to convince the developers of new water features and the bird feeders that their actions may increase the flight safety risk. A simple population model is discussed and two case studies presented.

(41) Automated Haze Systems with Methyl Anthranilate Eliminate Nuisance Birds in Aviation Hangars, Warehouses, Airports.

Bruce E. Vergote, BirdTec, Inc., 4074 155th Avenue, Hersey, MI 49677 USA

Automated haze systems (The BirdHazer) combined with Methyl Anthranilate (MA) is proven effective and cost efficient as an application method for eliminating nuisance birds in aviation hangars, warehouses, and airport facilities. Proper placement of the BirdHazer system which is based on air flow circulation allows to deliver a clean, dry haze, producing a mean droplet diameter size of 5 microns, which also eliminates the possibility of permeation and any settled residue. Three preliminary test studies were successfully completed at 2 dairy barn locations, and a salt storage warehouse. The fourth testing site was conducted at a maintenance hangar at Lemoore Naval Air Station, Lemoore, CA. This hangar had approximately 50 nesting pigeons (*Columba livia*). The BirdHazer unit was installed above an office in a back corner of the hangar. Concluding results indicate elimination of all birds within the 75-ft radius. A later discovery indicated that prevailing wind direction moved the MA product to the back of the maintenance building and did not provide total coverage of the area effectively. Follow-up testing will be done in the same hangar, with a two-head haze system accompanied with vortex fans behind each haze head to break up the product particles for more effective results. The BirdHazer also shows positive results with the use of the automated timed delivery system. At the Lemoore test site, the BirdHazer will be set at 30-sec intervals every 10 min during three 1-hour periods per day. Because of the 5-micron droplet size, this timing sequence allows the invisible haze to hang in the air up to 4 hours for complete coverage throughout the hangar.

(42) Responses of Captive Birds to Candidate Perching Deterrents on FAA LLWAS Units

Michael L. Avery and Ann C. Genchi, USDA, National Wildlife Research Center, 2820 East University Avenue, Gainesville, FL 32641 USA

Successful operation of the FAA's Low-Level Windshear Alert System (LLWAS) depends largely on birds not perching on the wind-sensing units which are installed atop poles 40-45 m tall. Because new LLWAS units will be erected at airports throughout North America, anti-perching devices must deter numerous avian species ranging widely in body size and behavioral pattern. To determine the most promising devices, we conducted pen trials with brown-headed cowbirds, fish crows, barred owls, great horned-owls and black vultures. Birds were given free access to an unmodified sensor unit mounted on a tripod for 24 hours, during which the only alternative perch was a tree branch at ground level. This was followed by 24 h with a perching deterrent installed on the sensor unit. Trials were video-taped 10 hours daily and the sensors were connected to a computer so that failures in acquisition of wind data due to perching activity were continuously recorded. Smaller birds (cowbirds, crows) tended to perch on the 3 arms of the sensor units and were mostly deterred by □ Bird Spinners □, metal bushings slipped onto the sensor arms that turned freely and prevented the birds from obtaining a stable perch. Owls and vultures were not affected by "Bird Spinners", but "AgSpikes" (sharp, stout spikes emanating from a central base) reduced perching 95-98%. With the "AgSpikes" or "AgCone" (a smooth, solid aluminum cone) installed, owls and vultures attempted to perch but departed when they were not able to obtain a comfortable, stable grip. Commercial bird spikes and a monofilament web attached to the sensor arms were each ineffective regardless of species. It appears that a single perch deterrent device will not suffice for all birds, but a combination of "Bird Spinners" with "AgSpikes" or "AgCone" should be appropriate for most situations. Verification of these findings with field testing is needed.

(43) Evaluation of Electrobraided Fencing as a Deer Barrier

Thomas W. Seamans, and Zachary J. Patton, USDA, National Wildlife Research Center, Ohio Field Station,
6100 Columbus Avenue, Sandusky, OH 44870 USA

Kurt C. VerCauteren, USDA, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO
80521 USA

Increasing white-tailed deer (*Odocoileus virginianus*) populations in North America have led to direct threats to public safety as well as agricultural losses. Fencing is often used to keep deer from causing damage at both airports and agricultural areas. Tall, chain-link fences have been used successfully but are often prohibitively expensive. Electric fences have potential to offer a less expensive alternative. We tested a new electric fence design marketed under the name ElectroBraid. This fence, comprised of 0.6-cm polyester rope with copper wire woven into it, is carried on frangible, fiberglass posts set at 15-m intervals. From January to March 2002 we conducted both 1- and 2-choice tests on free-ranging deer in northern Ohio. We measured deer intrusions and corn consumption at 10 pairs of fenced sites with and without electricity. Mean deer intrusions at treated sites in both 1- and 2-choice tests were < 1/day while control site intrusions were 84-86/day. Mean corn consumption by all wildlife (e.g., deer, raccoons [*Procyon lotor*], fox squirrels [*Sciurus niger*]) differed between treated (< 2 kg/day) and control sites (15 kg/day). Based upon the results of this test and the cost of ElectroBraid we conclude that this fence, under the conditions of this 5-week test, was an effective and economical deer barrier.

POSTERS (Hyatt Regency Sacramento – Regency DEF)

(P1) "Birdstrike" – What's the Word?

Carla Dove, Smithsonian Institution, National Museum of Natural History, Division of Birds, E610, MRC 116,
Washington, DC 20560-0116 USA

The word(s) "bird strike", "bird-strike", or "birdstrike" has been used inconsistently throughout the literature for as long as birds have been colliding with aircraft. A recent search of peer-reviewed articles in the Zoological Record and Biological Abstracts dating back to 1969 resulted in 52 articles that pertained to bird-aircraft collisions. Of those, 67% used two words (bird strike); 22% used a hyphenated word (bird-strike); 5.5% used one word (birdstrike), and 5.5% actually used both two words and the hyphenated version in the same paper! A brief glance through the proceedings and abstracts of recent *Bird Strike Committee Meetings* also exemplifies the inconsistent use of the word(s) that we apply to our profession.

The *Oxford English Dictionary* (1989) lists bird-strike as a hyphenated word under section (9) Special comb[inations]... of the word bird. However, they go on to cite references of the first published versions of this word in newspaper articles which quoted it as one word 'birdstrike' (*Daily Telegraph*, 19 June 1963; *Idle Moments*, 15 Oct. 1967). For this discrepancy, we turned to the scientific literature. According to the rules of scientific nomenclature (*The International Code of Zoological Nomenclature* [1964] Article 23 - Law of Priority)... "The valid name of a taxon is the oldest available name applied to it...[published]" Although this rule was established to settle differences in the proper naming of species and not inventing words for the English language, it is referenced here because interviews with a linguist (Dr. Suzanne Kemmer, Rice University, personnel communication) revealed that there are no English rules for creating compound words. However, the normal evolution of a new word is generally from two words - to a hyphenated word - to one word, depending on the frequency of use. Therefore, even if we dismiss the scientific rules of "The Code", the term for bird-aircraft collisions has been in use since at least the early 1960s. This year marks the 12th annual meeting of *Bird Strike Committee USA*. It is time that we begin consistent use of **BIRDSTRIKE** as one word in published articles and recommend a change in the Air Force Pamphlet 91-212 (1 April 1997 - Safety) to reflect the modern day, modern-day, or modernday use of the word.

(P2) Birdstrike Identification

Carla Dove, Smithsonian Institution, National Museum of Natural History, Division of Birds, E610, MRC 116, Washington, DC 20560-0116 USA

Identification of feather evidence retrieved from birdstrikes provides essential information that allows airfield managers, engineers, pilots and government agencies to work together to prevent damaging birdstrikes. Knowing the identity of the birds that are causing problems is the first step in formulating a plan to discourage birds from interfering with aviation safety. The feather identification process is complex and involves cleaning feather material, microscopic examination, and whole feather comparisons with specimens in a museum collection. This poster presents the feather identification technique and provides information to various agencies on how and where to send birdstrike remains for identification.

(P3) Attracting Arctic Foxes to Relocate a Gull Colony at Keflavik International Airport

Pall Hersteinsson, Institute of Biology, University of Iceland, Grensasvegur 12, IS-108 Reykjavik, Iceland
Gudmundur Örn Jonsson, Environmental Division, Naval Air Station Keflavik, Building #501, IS- 235 Keflavikurflugvöllur, Iceland

The Lesser Black-backed Gull (*Larus fuscus*) colony at Keflavik International Airport has grown from around 1,000 pairs in 1975 to over 20,000 pairs in the early 1990s and to around 30,000 pairs in 2000. The colony is considered a serious hazard to both military and civil air traffic. The population of arctic foxes (*Alopex lagopus*), the only predator in Iceland capable of preying on these gulls, was very small in this area from the late 1950s until the mid-1980s. A decade ago we noted that the location of the colony had shifted away from an arctic fox breeding den near the airport. As there were no natural arctic fox breeding dens at the location of the gull colony and as the geography was not suitable for such dens, we constructed an artificial den there in autumn 2000 to attract arctic foxes to breed there. The design of the den was based on that of a natural arctic fox den excavated elsewhere. Between January and April 2001, bird carcasses were placed at the artificial den on a regular basis to attract the foxes' attention to the den. Tracks in snow showed that foxes visited the den and removed the gull carcasses. Two vixens, one pregnant and the other lactating, were killed in the vicinity of the den in May and June 2001, respectively, and it was not used as a breeding den that year. We propose that arctic foxes should be totally protected in the area in order to test (a) whether wild arctic foxes are prepared to use an artificial den for rearing their pups, and (b) whether the occupation of a strategically placed den will result in a relocation of the gull colony to an area where aviation hazards are not a problem.

(P4) Identification of Batstrikes

Suzanne C. Peurach, USGS Patuxent Wildlife Research Center, Smithsonian Institution, Division of Mammals, National Museum of Natural History, Washington DC 20560 USA

Identification of fragmentary evidence such as hairs, bones, and claws that have been recovered from United States Air Force (USAF) aircraft has been undertaken by the Biological Survey Unit (USGS) for the last 5 years. The results of these investigations may be useful in preventing future damaging batstrikes. Examination of batstrikes may also provide valuable information to the scientific research community about patterns in bat migration, flight altitudes, and times of flight. Positive identifications are made by comparing unknown samples with the collection of museum specimens housed in the Smithsonian Institution's National Museum of Natural History. Macroscopic characters such as color, texture, and size help narrow the possibilities, while microscopic features such as patterns seen in scales and medulla of the hair can be used to distinguish major groups of bats. All but eight of the 70 reported wildlife strikes during this reporting period were identified to species level. The Brazilian free-tailed bat (*Tadarida brasiliensis*) was struck 23 times, while the red bat (*Lasiurus borealis*), was identified from 15 strikes. The hoary bat (*Lasiurus cinereus*) was only identified in 10 strikes although this large species of bat caused the most damage to USAF aircraft. Damage reported from these strikes by the USAF totaled over \$50,000. One strike alone caused over \$21,000

in damage. An examination of damage caused by different species indicates that Brazilian free-tailed bats caused approximately \$12,000 while the second most commonly hit bat, the red bat, caused no damage, even though several strike reports documented multiple impacts with these bats. These results indicate that body mass plays a large role in damages incurred by collisions with these bats.

(P5) Conducting an Economical Wildlife Hazard Assessment Using a Wildlife Incursion Log

Elizabeth Rogers and David Tiller, White Water Associates, Inc., 429 River Lane, Amasa, MI 49903 USA

Small and moderate-sized airports face increasing financial constraints. A need for a wildlife hazard assessment can represent a real financial hardship. We describe how a wildlife incursion log maintained by airport personnel can provide an economical means of assessing wildlife hazards in a rural landscape. Using such a log with records for 208 days, we created a relational database that could be analyzed with simple summary statistics. Using the incursion log, we examined seasonal shifts in average daily incursions (such as increased sandhill cranes in the spring), persistent year-round presence of some species (such as American crow), and the influence of time of day on the percentage of incursions by species (most incursions occurred in the morning hours). Flock size was also frequently recorded, allowing us to assess average flock size by month and frequency of flock sizes for various species. Some modest improvements and training of personnel in identification and record keeping would further enhance the usefulness of this type of data collection. We conclude that assisting small airports with the set up of a wildlife incursion log can be useful for both hazard assessments as well as ongoing monitoring needed in an adaptive management protocol.

(P6) Status of North American Canada Goose Populations

John L. Seubert, USDA, National Wildlife Research Center-Retired, 1800 Zinnia Rd., Golden, CO 80401 USA

North American Canada goose (*Branta canadensis*) populations continue to increase, causing potentially greater hazard to aviation. There is greater interest by biologist and aviation interests in monitoring the status of these populations because of the increasing number of Canada goose strikes to aircraft. Waterfowl in North America are managed in four administrative flyways – the Atlantic, Mississippi, Central, and Pacific. Goose numbers in these flyways are based on mid-winter or breeding period counts. The Canada goose count for North America in 2000 was 5,728,000—61% were the large resident geese. The resident component of the population has increased more than 3-fold from 1990-2000. Reported Canada goose strikes on aircraft have increased during recent years. For the years 1990-2001, Canada geese were identified in 61% of all goose strikes (606 of 985) reported to the FAA. Also, during the same reporting period, geese caused engine damage in 139 of the 985 strikes. Canada geese damaged 61% of the engines (85 of 139). The numbers of operating commercial jet aircraft and scheduled departures by airlines increase yearly. The higher number of Canada goose strikes probably is due to a greater awareness of the hazard and better reporting of strikes, and to the exposure of more commercial aircraft to increasing Canada goose populations. Aggressive integrated Canada goose management programs should continue or be undertaken to reduce this hazard.

(P7) Environmental Analysis of Wildlife Hazard Management Programs: Application of NEPA and Possible Consequences for Implementing New Plans

Ken Wallace, SWCA, Inc., 906 Stuart Street, Helena, MT 59601 USA

The operating certificate required for airports that accommodate commercial-service air carriers stipulates that the airports be able to conduct safe operations, pursuant to the Federal Aviation Act of 1958. Under Federal Aviation Regulation Part 139, most airports must prepare and implement a wildlife hazard management plan (WHMP) as part of the certification process. Required components of the WHMP include the *priorities for needed habitat modification and changes in land use* as a result of those modifications. Because habitat modification is often a relatively permanent procedure to reduce wildlife use of airports, it is a preferred method by airport operators for hazard abatement. There are likely to be federal and state permits associated

with habitat modifications, such as those needed for wildlife removal, discharges to surface water, or dredging and filling activities in wetlands. However, proposed activities to reduce or eliminate habitat at Part 139-certified airports are also subject to review under the National Environmental Policy Act (NEPA). Virtually all activities involving federal funding or approval at these airports require some level of analysis for compliance with NEPA; most of these activities are either specifically categorically excluded from a formal environmental assessment, or need at most an environmental assessment to document the lack of significant environmental impacts. In contrast, modifications to most "natural" wildlife habitats, even those undertaken to increase aviation safety, are not categorically excluded from environmental assessment. It is reasonable to assume that habitat modifications would in most instances require preparation of an environmental impact statement, either because of the potential to result in significant effects on the environment or the highly controversial nature of the activity. The reasoned, procedural nature of NEPA and the often-lengthy EIS process may appear to conflict with the urgency associated with wildlife hazard reduction at airports. A case study in southeast Alaska is used to illustrate the influence of NEPA on wildlife hazard management, in particular habitat modification actions.

(P8) Successful use of Alarm/Alert Call Playback to End Canada Goose Problems at an Ohio Business Park

Dr. Philip C. Whitford, Biology Department, Capital University, 2199 E. Main St. Columbus, OH 43209 USA

Burgeoning continental resident Canada goose populations have led to increases in aircraft strikes. Once on or near airfields, geese have proven difficult to move and keep away. Playback of naturally recorded alarm and alert calls of the species was coupled with multiple harassment techniques to determine if this strategy would prove effective at removal of long-term resident geese from a 24-ha business park in Dayton, Ohio. The study began 26 February 2002, following territorial establishment by the geese, and continued until the last few geese had abandoned the property as of 14 May 2002. Most geese present were reusing nest territories from previous years, and thus strong nest-site fidelity made these perhaps the most difficult of all geese to remove in a nonlethal manner. Call playback used three "Goosebuster" units (Bird-X Corp. Inc., Chicago IL). Daily direct human harassment consisted of chasing geese on foot and placing objects such as owl decoys, sticks, or balloons in nests. Other harassment included sporadic use of two Chesapeake retrievers over 7 mornings, but this harassment was not considered essential to discourage return by geese. Reports of goose aggression toward and injury to employees fell from 32 and 2 cases, respectively, in 2001 to zero in 2002. Employee time spent in harassment fell from 3-4 hours/day at the start to under 15 minutes/day. Goose droppings/100 m of walks fell from a mean of 195.7 to 3.3 between 26 February and 24 March 2002, a 98% reduction ($P < 0.01$), and remained low thereafter. Twice daily cleaning of walks done prior to the study was deemed unnecessary by week 2 of the study, more than offsetting employee time in harassment activities. Continued alarm-call playback at random 10- to 20-minute settings appeared to help prevent return of resident geese or recolonization of the property by other geese. Goose use of the property dropped from 1600-1800 goose-hours/day before testing to fewer than 150 goose-hours/day by week 3 and to zero hours by May. Similar techniques may prove useful as nonlethal means to remove geese from areas on or near airports where they constitute a threat to air traffic.

(P9) Animal Ambush at the Airport: The Extent and Nature of Non-bird Wildlife Strikes with Civil Aircraft, USA, 1990-2001

Sandra E. Wright, USDA, National Wildlife Research Center, 6100 Columbus Ave., Sandusky, OH 44870 USA
Richard A. Dolbeer, USDA, Wildlife Services, 6100 Columbus Ave., Sandusky, OH 44870 USA

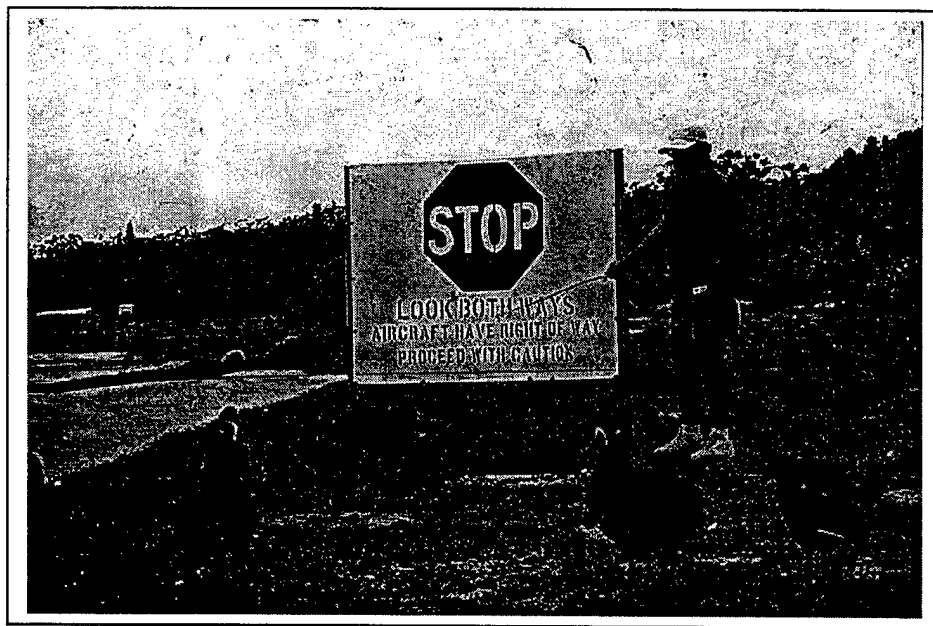
Birds have long been recognized as a serious threat to aviation safety. However, other wildlife (mammals and reptiles) can also have a serious impact on aircraft. From 1990-2001, 1,029 strikes to civil aircraft involving wildlife other than birds were reported to the Federal Aviation Administration (FAA). Deer (522) and coyotes (115) were the most commonly struck wildlife. Other non-bird species struck included rabbits, woodchucks, turtles, alligators, and iguanas. Whereas 14% of bird strikes resulted in aircraft damage and 9% had a negative

effect on the flight, 47% of strikes with other wildlife caused damage and 33% had a negative effect on the flight. Although non-bird wildlife strikes represented less than 3% of the reported strikes in the FAA national database from 1990-2001, 13 (54%) of the 24 civil aircraft that were destroyed due to wildlife strikes were caused by these non-bird species. We conclude that 1) Birds are not the only wildlife hazard to aviation. Runway incursions by various mammals and reptiles can result in major damage to aircraft and loss of life and must be taken seriously; 2) In the USA, these wildlife strikes should be reported to the FAA in the same manner as bird strikes. The International Civil Aviation Organization (ICAO) presently collects data on bird and bat strikes. ICAO should include other wildlife strikes in its database; and 3) We propose that the size limit for reporting non-bird strikes, other than bats, be animals greater than 200g (the size of a Norway rat [*Rattus rattus*] or about ½ pound). All bat strikes should be reported.

NOTES

DID YOU KNOW THAT?

- Over 400 people have been killed and 400 aircraft destroyed worldwide as a result of wildlife strikes.
- Wildlife strikes cost USA civil aviation over \$400 million/year, 1990-2001.
- About 5,700 bird strikes were reported for USA civil aircraft in 2001. The U.S. Air Force recorded over 3,700 bird strikes in 2001.
- Over 2,700 bird strikes at heights >3,000 feet above ground level were reported for USA civil aircraft, 1990-2001; 113 of these strikes resulted in substantial damage to the aircraft.
- An estimated 80% of bird strikes to USA civil aircraft go unreported.
- Waterfowl (31%), gulls (29%), and raptors (17%) comprised 77% of the birdstrikes to civil aircraft in which damage was reported, USA, 1990-2001.
- Over 500 civil aircraft collisions with deer were reported in the USA, 1990-2001.
- A 12-lb (5.5 kg) Canada goose struck by an aircraft at 150-mph generates the force of a 1,000-lb weight dropped from a height of 10 feet.
- Starlings (3 oz, 80 g) are “feathered bullets”, having a body density 27% higher than herring gulls.
- From 1990-2001, 607 unidentified hawks, 552 American kestrels, 332 red-tailed hawks, 51 eagles (bald and golden), and 35 peregrine falcons were reported as struck by civil aircraft, USA.
- Thirteen of the 14 bird species in North America with body masses greater than 8 lbs (3.6 kg) have shown significant population increases, 1970-2000. The North American non-migratory Canada goose population more than tripled from about 1 million to 3.5 million birds, 1990-2000.



Wildlife Strikes in the News

SAS jet flies into flock of gulls

STOCKHOLM, April 9, 2001 (Reuters) - A SAS jet carrying 100 passengers flew into a flock of seagulls and was forced to return immediately to the airport to check for damage.

German tourists

MOMBASA, Kenya, April 10, 2001 (Reuters) - A charter plane carrying more than 100 German tourists made an emergency landing at Kenya's second largest city of Mombasa on Monday after one of its engines sucked in two flamingos and caught fire, officials said.

Plane lands early after hitting bird

Monday August 5, 2002 6:08 PM EDT
The Hamilton Spectator
Apr 10, 2001 01:50 AM

Errant gull sparks plane fire

Carmelina Prete
The Hamilton Spectator

A WestJet Boeing 737 with 62 passengers aboard was forced to return to the Hamilton airport yesterday after a gull was sucked into an engine, starting a fire. Left to right, passengers David

Australia 25 May 2001

Fox cause of Ansett 737 grounding

An Ansett 737 is not expected to be back in the air until its engine is replaced.

The plane was flying from Melbourne to Sydney when the problem was discovered at 11:30 a.m.

Jet blows

The A-

Plane crash kills 21 in rebel-held Congo
KIGALI, April 20 (Reuters) - At least 21 people including five Rwandan army officers were killed when a plane crashed in the east of the Democratic Republic of the Congo, army officials said on Thursday. They were unable to maintain contact with the plane after it took off from Kigali on Wednesday night, when the plane was carrying 21 people.

takeoff is aborted

Jan, January 22, 2001

Delta Air Lines flight aborted takeoff at Ronald Reagan Washington National Airport yesterday afternoon after a bird hit the engine.

Airline Hits Birds but Lands Safely at

February 23, 2000
Philadelphia flight to Los Angeles returned after bird ingested in engine.
SACRAMENTO, BEE

2 survive crash after plane hits deer at Troy field

01/15/01
WILLIAM THORNTON
staff writer
report plane
and it landed with
to Dallas Cowboys' owner
er and then burst into flames
Regional Airport Sunday.

a fox was sucked

DISASTER ON FLIGHT 587
American has another
Airbus scare at JFK
Jet forced to land in engine
emergency; birds blamed

By Paul Sperry
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An American Airlines flight to the Caribbean was forced to land Friday at John F. Kennedy International Airport after the pilot reported problems with one of the Airbus A300 engines, company officials confirmed today.

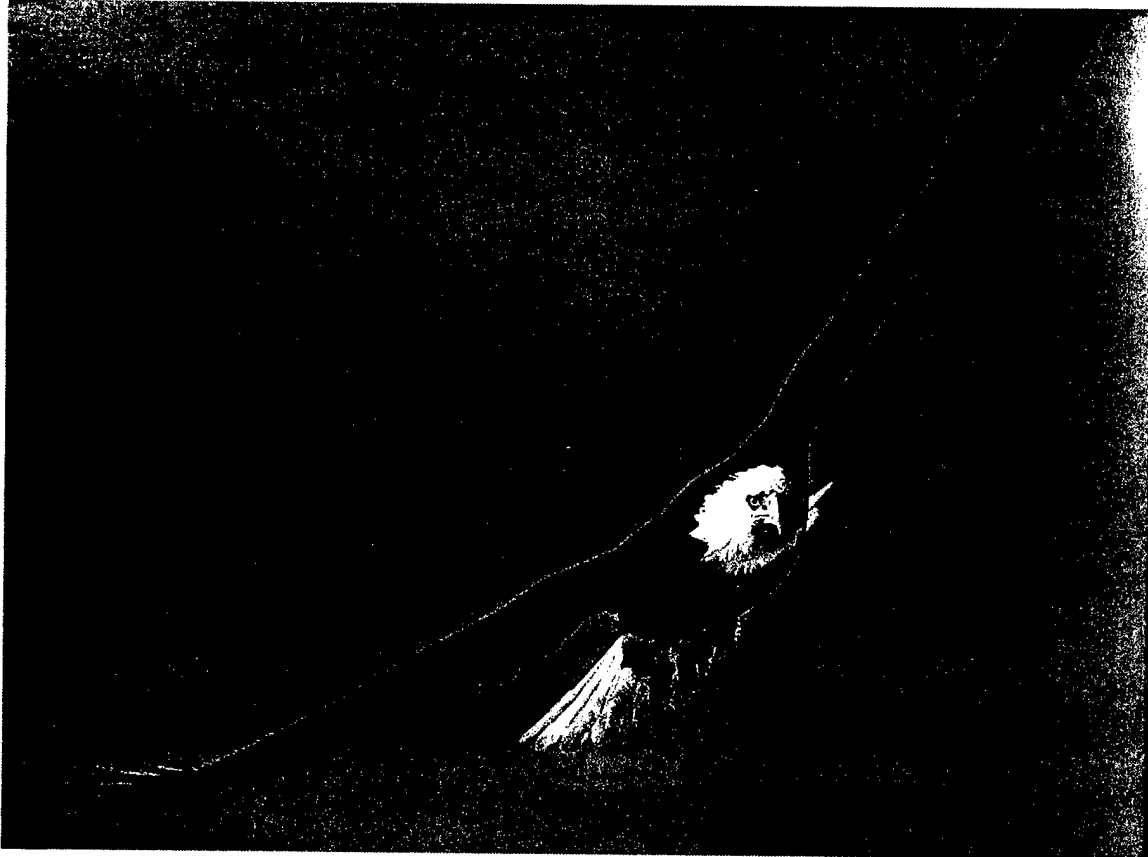
An American spokesman in Dallas blamed the emergency landing on a flock of birds likely flying south for the winter.

LOCATIONS OF ANNUAL MEETINGS BIRD STRIKE COMMITTEE-USA

August 1991	Atlantic City International Airport (FAA Technical Center)	Atlantic City, New Jersey
August 1992	JFK International Airport	New York, New York
August 1993	SEATAC International Airport	Seattle, Washington
August 1994	O'Hare International Airport	Chicago, Illinois
August 1995	Dallas/Ft. Worth International Airport	Dallas, Texas
July 1996	Phoenix Sky Harbor International Airport	Phoenix, Arizona
August 1997	Logan International Airport	Boston, Massachusetts
June 1998	Burke Lakefront Airport	Cleveland, Ohio
May 1999*	Vancouver International Airport	Vancouver, BC
August 2000*	Minneapolis/St. Paul International Airport	Minneapolis, Minnesota
August 2001*	Calgary International Airport	Calgary, Alberta
October 2002*	Sacramento International Airport	Sacramento, California

* Joint meeting with Bird Strike Committee Canada.

THANKS SACRAMENTO!



Safer Skies for All who Fly—Birds and People!

Bird Strike Committee USA thanks the Sacramento County Airport System for hosting the 4th Joint USA/Canada Meeting. The Committee also thanks USDA, Wildlife Services and the USAF, Office of Scientific Research for their support of the conference. We look forward to seeing you and your colleagues in Toronto in 2003 and at future meetings.

Richard A. Dolbeer, Chairperson, BSC-USA 2002